UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW ENGLAND - REGION I
ONE CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

FACT SHEET

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT TO DISCHARGE TO WATERS OF THE UNITED STATES PURSUANT TO THE CLEAN WATER ACT (CWA)

NPDES PERMIT NUMBER: **MA0004073**

NAME AND MAILING ADDRESS OF APPLICANT:

Twin Rivers Technologies US Inc.
780 Washington Street
Quincy, MA 02169

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

Twin Rivers Technologies US Inc.
780 Washington Street
Quincy, MA 02169

RECEIVING WATER(S): **Weymouth Fore River and Town River Bay**
Weymouth and Weir River Basins (MA74)

RECEIVING WATER CLASSIFICATION(S): **SB**

SIC CODE: **2841 - Soap and Other Detergents, Except Specialty Cleaners**
2899 - Chemicals and Chemical Preparations, Not Elsewhere Classified
2869 - Industrial Organic Chemicals, Not Elsewhere Classified

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I. Proposed Action, Type of Facility, and Discharge Location

The above named applicant has applied to the U.S. Environmental Protection Agency (EPA) for re-issuance of a National Pollutant Discharge Elimination System (NPDES) permit to discharge non-contact cooling water (NCCW) and storm water into the designated receiving water. Twin River Technologies (TRT) is engaged in the manufacture of oleic and stearic fatty acids and crude glycerin for surfactant and rubber industries. The existing permit was signed on October 31, 2002 and became effective on the date of signature. This permit expired four years from the effective date, on October 31, 2006. On September 28, 2007 a transfer of ownership from Twin River Technologies, LP to Twin River Technologies Quincy, LLC occurred. In November 2008 a transfer of ownership from Twin River Technologies Quincy, LLC to Twin River Technologies US Inc. occurred. Henceforth all coverage is granted to Twin River Technologies US Inc.

II. Description of Discharge

A quantitative description of the effluent parameters based on recent discharge monitoring reports (DMRs) is shown on Attachment B of this fact sheet.

III. Receiving Water Description

TRT is located at the confluence of the Town River Bay and Weymouth Fore River in Quincy, MA (Attachment A). These waterbodies have been classified as Class SB under the Massachusetts Surface Water Quality Standards (WQSs). Title 314 Code of Massachusetts Regulations ("CMR") 4.05(4)(b) states that Class SB waters have the following designated uses: *These waters are designated as habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration (Restricted Shellfish Areas). These waters shall have consistently good aesthetic value.*

The water in the vicinity of the facility is a tidal estuarine waterbody that is subject to semi-diurnal tidal flows with a mean tidal range of 9.49 feet. The area immediately surrounding TRT is a designated port area which is heavily used by recreational boat traffic during the summer. Operations in the area include petroleum offloading/storage, wastewater treatment, commercial/municipal power generation, MBTA ferries, and hazardous waste processing. Due to the large amount of industrial activity in the area, both the Town River Bay and the Weymouth Fore River have been significantly modified from their natural states. Large portions of the shoreline are covered by a bulkhead of granite block, steel sheet pile, or stone riprap. In the Weymouth Fore River there is also a dredged shipping channel with a depth of approximately 33 feet at mean lower low water (MLLW) to allow the passage of deep draft vessels.

Section 303(d) of the Federal Clean Water Act (CWA) requires states to identify those waterbodies that are not expected to meet surface WQSs after the implementation of technology-based controls and, as such require the development of total maximum daily loads (TMDL). The final 2008, 303(d) report states that the Weymouth Fore River (MA74-14), from Route 53 in

Braintree to mouth (eastern point at Lower Neck, Weymouth and western point at Wall Street on Houghs Neck, Quincy), is not attaining WQSs due to Pathogens. The Town River Bay (MA74-15), from the headwaters at the Route 3A bridge to the mouth at Weymouth-Fore River between Shipyard and Germantown Points, Quincy, is not attaining WQSs due to organic enrichment/low dissolved oxygen (DO) and pathogens. The discharge from this facility is not expected to contribute to the pathogen impairment; however, the thermal discharge does have the potential to impact the concentration of DO.

IV. Limitations and Conditions

The effluent limitations of the draft permit, the monitoring requirements, and any implementation schedule (if required) may be found in the draft permit.

V. Permit Basis: Statutory and Regulatory Authority

The Clean Water Act (CWA) prohibits the discharge of pollutants to waters of the United States without a NPDES permit unless such a discharge is otherwise authorized by the CWA. The NPDES permit is the mechanism used to implement technology and water quality-based effluent limitations and other requirements including monitoring and reporting. This Draft NPDES permit was developed in accordance with various statutory and regulatory requirements established pursuant to the CWA and applicable State regulations. During development, EPA considered the most recent technology-based treatment requirements, water quality-based requirements, and all limitations and requirements in the current/existing permit. The regulations governing the EPA NPDES permit program are generally found at 40 CFR Parts 122, 124, 125, and 136. The general conditions of the Draft Permit are based on 40 CFR §122.41 and consist primarily of management requirements common to all permits. The effluent monitoring requirements have been established to yield data representative of the discharge under authority of Section 308(a) of the CWA in accordance with 40 CFR §122.41(j), §122.44(i) and §122.48.

A. Technology-Based Requirements

Subpart A of 40 CFR §125 establishes criteria and standards for the imposition of technology based treatment requirements in permits under Section 301(b) of the CWA, including the application of EPA promulgated effluent limitations and Best Professional Judgement (BPJ), for case-by-case determinations of effluent limitations under Section 402(a)(1) of the CWA.

Technology-based treatment requirements represent the minimum level of control that must be imposed under Sections 301(b) and 402 of the CWA (See 40 CFR §125 Subpart A) to meet best practicable control technology currently available (BPT) for conventional pollutants and some metals, best conventional control technology (BCT) for conventional pollutants, and best available technology economically achievable (BAT) for toxic and non-conventional pollutants. In general, technology-based effluent guidelines for non-POTW facilities must have been complied with as expeditiously as practicable but in no case later than three years after the date such limitations are established and in no case later than March 31, 1989 [See 40 CFR §125.3(a)(2)]. Compliance schedules and deadlines not in accordance with the statutory provisions of the CWA can not be authorized by a NPDES permit.

On June 29, 1995 EPA promulgated effluent limitation guidelines for the Soap and Detergent Manufacturing Point Source Category at 40 C.F.R. §417. Subpart B applies to the manufacturing of fatty acids by fat splitting. Although this process occurs at the facility (see Part IV.A of Fact Sheet), process wastewater is treated on-site and discharged to the local POTW; no wastewater associated with the process is discharged through either permitted outfall. Therefore, the ELGs at 40 C.F.R. § 417 do not apply. In the absence of applicable technology-based effluent guidelines, the permit writer is authorized under Section 402(a)(1)(B) of the CWA to establish effluent limitations on a case-by-case basis using BPJ.

B. Water Quality-Based Requirements

Water quality-based criteria are required in NPDES permits when EPA and the State determine that effluent limits more stringent than technology-based limits are necessary to maintain or achieve state or federal water quality standards (See Section 301(b) (1)(C) of the CWA). Water quality-based criteria consist of three (3) parts: 1) beneficial designated uses for a water body or a segment of a water body; 2) numeric and/or narrative water quality criteria sufficient to protect the assigned designated use(s) of the water body; and 3) anti-degradation requirements to ensure that once a use is attained it will not be degraded. The Massachusetts State Water Quality Standards (WQSs), found at 314 CMR 4.00, include these elements. The State WQSs limit or prohibit discharges of pollutants to surface waters and thereby assure that the surface water quality standards of the receiving water are protected, maintained, and/or attained. These standards also include requirements for the regulation and control of toxic constituents and require that EPA criteria, established pursuant to Section 304(a) of the CWA, be used unless site-specific criteria are established. EPA regulations pertaining to permit limits based upon water quality standards and state requirements are contained in 40 CFR §122.44(d).

Section 101(a)(3) of the CWA specifically prohibits the discharge of toxic pollutants in toxic amounts. The Commonwealth of Massachusetts has a similar narrative criteria in their water quality regulations that prohibits such discharges [See Massachusetts 314 CMR 4.05(5)(e)]. The effluent limits established in the Draft Permit assure that the surface water quality standards of the receiving water are protected, maintained, and/or attained.

C. Anti-Backsliding

EPA's anti-backsliding provision as identified in Section 402(o) of the Clean Water Act and at 40 CFR §122.44(l) prohibits the relaxation of permit limits, standards, and conditions unless the circumstances on which the previous permit was based have materially and substantially changed since the time the permit was issued. Anti-backsliding provisions apply to effluent limits based on technology, water quality, BPJ and State Certification requirements. Relief from anti-backsliding provisions can only be granted under one of the defined exceptions [See 40 CFR §122.44(l)(i)]. Since none of these exceptions apply to this facility, the effluent limits in the Draft Permit must be as stringent as those in the Current Permit.

D. Anti-Degradation

The Massachusetts Anti-Degradation Policy is found at Title 314 CMR 4.04. All existing uses of the Town River Bay and Weymouth Fore River must be protected. The EPA anticipates that the MassDEP shall make a determination that there shall be no significant adverse impacts to the receiving waters and no loss of existing uses as a result of the discharge authorized by this permit. This Draft Permit is being reissued with allowable effluent limits as stringent as or more stringent than the Current Permit and accordingly will continue to protect the existing uses of the Town River Bay and Weymouth Fore River.

E. CWA §§ 316(a) and (b)

With any NPDES permit issuance or reissuance, EPA is required to evaluate or re-evaluate compliance with applicable standards, including those stated in Clean Water Act (CWA) Section 316(a) regarding thermal discharges and CWA §316(b) regarding cooling water intake structures. CWA §316(a) applies if the permit applicant seeks a variance from technology-based and water quality-based effluent limitations for the discharge of heat. To obtain a 316(a) variance, the applicant must demonstrate to the satisfaction of the EPA (or, if appropriate, the State) that the alternative effluent limitations proposed will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving water body. CWA § 316(b) applies if the permit applicant seeks to withdraw cooling water from a water of the United States. To satisfy § 316(b) the permit applicant must demonstrate to the satisfaction of the EPA (or, if appropriate, the State) that the location, design, construction, and capacity of the facility's cooling water intake structure(s) (CWIS) reflect the Best Technology Available (BTA) for minimizing adverse environmental impacts.

Both CWA §§ 316(a) and 316(b) apply to this permit; § 316(a) due to TRT's requested thermal discharge limits in excess of those allowed by state water quality standards and/or technology based limits, and § 316(b) due to the presence and operation of a cooling water intake structure. A detailed discussion of the requirements pertaining to these regulations is presented in Section VII of this Fact Sheet.

VI. Explanation of the Permit's Effluent Limitation(s)

A. Facility Information

The site of the TRT facility has been utilized as a manufacturing / refining operation since 1939. Manufacturing presently focuses on fatty acid and glycerin production to support various industries, primary of which is surfactant manufacturers. Fatty acids and glycerin are manufactured from animal fats and vegetable oils. Vegetable oil is brought to the facility by marine chemical tanker and animal fats are delivered via tank truck and rail cars. All products are shipped from the site via railcar and tanker truck. The glycerin and fatty acids are used by other facilities in the manufacturing of plastics, soap, detergent, cosmetics, and textiles.

Manufacturing processes include hydrolysis, fractionation, distillation, hydrogenation and supporting processes, such as boiler, analytical, maintenance and wastewater treatment systems. Hydrolysis is a high temperature, high pressure system that separates glycerin and fatty acids from both types of raw materials. Fatty acids then undergo fractionation or physical separation to attain different molecular chain lengths. These products then can be distilled in a single vaporization-condensation cycle for purification purposes. The fractionation and distillation processes use NCCW from the mechanical draft cooling tower and for the condensation portion of the cycles. Some fatty acids are then hydrogenated introducing hydrogen atoms to the unsaturated fatty acids for product hardening and stabilization. Glycerin is refined and proceeds either to evaporators that remove all water from the final product or to a distillation tower, which uses multiple vaporization-condensation cycles to separate the glycerin into various stages of purity based on different boiling points. The final products are then placed into storage before being taken off-site in rail cars or tanker trucks.

Water is supplied to the facility by the MWRA through the Quincy municipal supply system. The average daily municipal water use equals approximately 305,000 gallons of water per day (based on the Jan – April 2009 billing). This water is used as potable water; process water, especially in the hydrolysers; boiler makeup water; and cooling tower water. All process wastewater is routed to the on-site wastewater treatment facility, which discharges to the local POTW. Annual discharge is approximately 168,000 gallons of wastewater per day (based on 2008 flow data).

Hazardous waste storage is located in an area known as the West Garage. The West Garage also contains storage areas for sodium hydroxide, hydrochloric and sulfuric acid, and citric acid for wastewater treatment. The garage has primary spill protection in the form of bermed entries (some with secondary relief) and rooms that are dedicated to specific uses. All waste generated on site is disposed of as required by RCRA or by Massachusetts Code of Regulations. This area is inspected at minimum every 6 hours by trained staff. Sodium hydroxide and gasoline are delivered in bulk quantity. The load out point for sodium hydroxide is inside the bermed location. The gasoline is stored in a 5000 gallon double walled steel underground storage tank with interstitial monitoring.

Odor control systems at the facility utilize city water and rain water collected from the northern portion of the facility, to reduce odor from the manufacturing processes. Storm water used for odor control is collected from the northern half of the site in a series of catch basins and sumps. The drainage area consists mainly of the north tank field as well as the boat dock and part of the wastewater treatment facility. The tank field holds the fractionation towers, distillation towers, and storage of raw materials, finished products, and chemicals. Secondary containment is provided around the tank field and, as stated above, this area is inspected at a minimum of every 6 hours by trained staff. The flows from the drainage areas are stored in three storage tanks that feed the odor condensers. These tanks include two 70,000 gallon tanks and one 55,000 gallon tank. This volume of storm water is ultimately discharged to the local POTW after being used in the odor system. Storm water collected from the southern section of the facility is discharged through Outfall 001.

B. Cooling Water Intake Structure (CWIS)

The facility withdraws water from the Weymouth Fore River to use as once-through NCCW for the hydrogenation process. The intake structure is located on the east side of the facility underneath the boat dock, approximately 2.5 miles downstream from the Weymouth Fore tidal head and 300 feet from the confluence of the Weymouth Fore River and the Town River Bay. At mean lower low water (MLLW) the structure is approximately 11.35 feet below the surface and 25.5 feet below the wharf. Below the intake structure, the river bottom contours downward for another 22 feet, at a slope of 3:1 to reach a final depth of 33 feet. This is the depth of the channel, which was dredged by the Army Corps of Engineers (ACOE), at MLLW. The intake structure and tunnel were built in 1904, with current intake screens, racks, effluent pipe and other modifications added to the system later. This intake system was originally fully utilized as a cooling water supply for a municipal power generating station then later as cooling supply for a manufacturing facility.

The intake structure is comprised of two 4.5 feet diameter intake tunnels, the heads of which are located under a wharf that extends over the Weymouth Fore River. Each of the two intake tunnels is covered by a 6 inch gap width bar rack, which prevents larger debris from entering the tunnels. Approximately 3 feet beyond the bar racks, each tunnel splits into two 2.5 feet diameter pipes (for a total of four pipes) which contain ½ inch mesh screens to remove smaller bits of debris from the incoming water. These screens are pulled to the surface for cleaning approximately four times per year through two access hatches located on the concrete deck at the shoreline. Two feet beyond these mesh screens the four intake pipes merge into a common manifold, which subsequently leads into a single intake tunnel drawing water into the facility. Four existing pump intakes are located in the tunnels, each with a capacity of 1,846 gallons per minute (10.6 million gallons per day (MGD) total). TRT utilizes only two of these with variable frequency drive (VFD) pumps, for a total intake of approximately 5 MGD of cooling water.

C. Permitted Outfalls

1. Outfall 001

Storm water from the southern section of the facility is discharged through Outfall 001 into the Weymouth Fore River (see Attachment C). This area consists of 246,000 square feet and contains material storage, office space, a 3,000 gallon underground gasoline storage tank (with interstitial protection), part of the facility's industrial wastewater pretreatment system, a lift station, empty rail car storage tracks, and chemical storage rooms. According to TRT, if a spill were to occur within this section of the facility, a shut-off valve could be used to prevent contaminated storm water from being discharged. Were this to occur, the water would receive treatment in the on-site treatment facility prior to discharge. Storm water catch basins for the southern portion of the facility are not connected to those for the northern section of the facility.

2. Outfall 003

Outfall 003 discharges approximately 5 MGD of NCCW to the Town River Bay (see Attachment C). According to TRT's Response to EPA's Information Request Document, "there is no regular treatment of the cooling water effluent…" and "TRT does not use biocides or other chemicals during operation of the cooling system." The NCCW discharges through a 24 inch diameter pipe to a tidal mudflat where it receives no dilution from the Town River Bay. At high tide this pipe is approximately 7 feet below the surface of the water. Historical temperature data, presented in Attachment B, reflects the temperature of the NCCW discharge after it has mixed with the receiving water. The Draft Permit requires samples of this discharge to be taken at or prior to the point of comingling with the receiving water and to be free from storm water and/or tidal influence. This will ensure that temperature samples accurately reflect the discharge temperature from the facility and not allow for dilution.

D. Derivation of Effluent Limits under the Federal CWA and/or the Commonwealth of Massachusetts' Water Quality Standards

1. Flow

The Draft Permit contains a maximum daily and monthly average limit of 5.0 million gallons per day (MGD) for Outfall 003 as continued from the Expired Permit. This limit is based upon the capacity of the two VFD pumps used by the facility for seawater intake. There were no exceedances of the existing flow limit from January 2003 – April 2009.

2. pH

Massachusetts Surface WQSs require the pH of Class SB waters to be within the range of 6.5 to 8.5 standard units (s.u.). The Draft Permit identifies a pH permit limit range of 6.5 to 8.5 for both Outfall 001 and Outfall 003, which have been established in accordance with the State Surface WQSs. The discharge shall not exceed this pH range unless due to natural causes. In addition, there shall be no change from background conditions that would impair any uses assigned to the receiving water class.

3. Temperature

Massachusetts Surface WQSs for Class SB waters require that the in-stream temperature shall not exceed 85°F and that the rise in temperature due to a discharge shall not exceed 1.5°F (0.8°C) during the summer months (July through September) nor 4°F (2.2°C) during the winter months (October through June). Additionally, there shall be no change from background conditions that would impair any use designated to this class [314 CMR 4.05 (4)(b)]. Massachusetts WQSs do allow for the calculation of a mixing zone, which is limited to an area or volume as small as feasible, for the initial dilution of a discharge [314 CMR 4.03 (2)].

The Draft Permit limits the instantaneous maximum daily temperature of the discharge from Outfall 003 to 87°F. During the application process, TRT requested a §316(a) Thermal Variance to discharge NCCW at 95°F, with no restrictions on the rise in temperature due to the discharge at low tide. EPA has the authority to consider this request and either grant the requested variance-based thermal effluent limits, deny the variance request and establish water quality-based or technology-based thermal effluent limits, or deny the variance request and establish variance-based thermal effluent limits that are protective of the balanced indigenous population

(BIP). In this permitting action, EPA is denying TRT's §316(a) thermal variance request. When Outfall 003 discharges to a tidal mud flat and receives no dilution, EPA is establishing an alternative variance-based thermal effluent limit of 87°F, which is protective of the BIP. Additionally, EPA is granting the permittee's requested variance-based limit of no restrictions on the rise in temperature due to the discharge when the discharge is to the tidal mud flat and receives no dilution (explained in detail in Part VII.A of this Fact Sheet).

When Outfall 003 is submerged in the Town River Bay, EPA is establishing a water quality-based thermal effluent limit of 87°F in the Draft Permit. At these times, the discharge receives adequate dilution to meet Massachusetts Surface WQSs after the establishment of a mixing zone. The Massachusetts WQSs Implementation Policy for Mixing Zones states that "…at least half of a waterbody's area or volume shall remain free from mixing zones" in order to provide a zone of passage for organisms. Assuming the facility discharges at the permitted flow limit of 5 MGD and at the Draft Permit temperature limit of 87°F, the mixing zone for TRT covers a maximum of 475,419.44 square feet in the summer and 437,738.05 square feet in the winter (Appendix D). This is a conservative approximation which does not account for dilution provided by ambient water at depths greater than the mudflats. Given the location of the outfall in the waterbody and the dilution calculations in Appendix D, it is highly unlikely that this mixing zone will exceed 50% or more of the channel width (approximately 540 feet) at the mouth of the bay. Therefore, the mixing zone established for the discharge when Outfall 003 is submerged is expected to provide a zone of safe passage for organisms and represents an area that is as small as feasible.

The Draft Permit does not require monitoring to measure the rise in temperature of the Town River Bay when Outfall 003 is submerged because the calculations in Appendix D demonstrate the ability of the discharge to meet Massachusetts WQS for rise in temperature. However, the Draft Permit does require the permittee to conduct an Ambient Temperature and Mixing Zone Study to confirm the location of the mixing zone and the influence of the TRT's thermal discharge on the Town River Bay during all tidal conditions. For this Study, the permittee is required to collect temperature samples during seven consecutive days in March and seven consecutive days in August, from an array of thermistors, all deployed at a depth of one meter at approximately equal intervals across transects of the Town River Bay at the following locations:

- Five individual thermistors across a transect of the mouth of the channel entering the Town River Bay, starting at the northeast corner of the facility (location A on Figure 1).
- Five individual thermistors across a transect of the mouth of the channel entering the Town River Bay, starting at the northwest corner of the facility (location B on Figure 1).
- Five individual thermistors across a transect of the Town River Bay approximately 500 feet from the discharge point (location C on Figure 1).
- Five individual thermistors across a transect of the Town River Bay approximately 1,000 feet from the discharge point (location D on Figure 1).

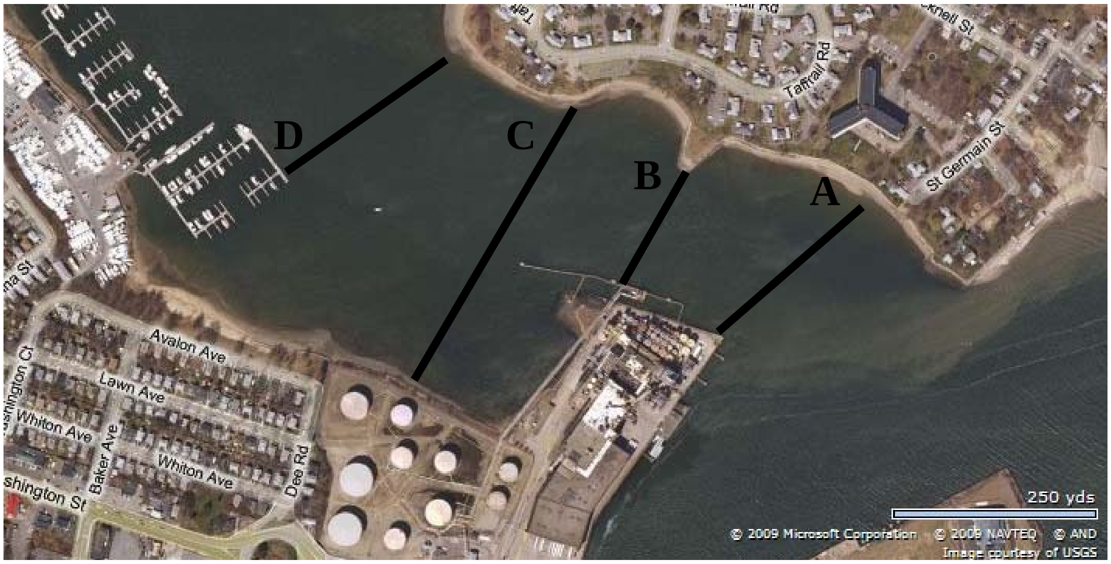

Figure 1: Approximate Locations for Transects of Thermistors in the Ambient Temperature and Mixing Zone Study

Each thermistor shall be equipped with a data logging device to allow the development of a continuous data record. The permittee is solely responsible for gaining all permits and authorizations necessary for the placement of the thermistors in the Town River Bay. The results of this study will be used during future reissuance(s) or modification(s) of the permit and must be submitted to EPA and MassDEP as part of the monthly DMR submission.

According to the permittee, the historical effluent temperature samples presented in Attachment B were taken at the point of discharge during high tide, and therefore contain dilution. The Draft Permit requires that sampling of the effluent temperature occur prior to co-mingling with the receiving water to ensure that the samples are representative of the discharge. This may be accomplished either by sampling during low tide or by selecting a sampling location before the discharge comingles with the receiving water. During the month of May 2008, TRT collected end-of-pipe temperature samples from Outfall 003 that, unlike the data presented in Attachment B, are free from tidal influences. The range of these temperatures samples is below the WQS of 85 ºF, and therefore the discharge is expected to meet the temperature limits in the Draft Permit.

4. Total Suspended Solids

The Draft Permit contains a daily maximum limit of 100 mg/l for Outfall 003. This limit is continued from the Expired Permit in accordance with anti-backsliding regulations (40 CFR §122.44(l)). The limit in the Expired Permit was based on best professional judgement in consideration of the ELGs for the Steam Electric Power Generating Point Source Category and the October 30, 2000 NPDES Storm Water Multi-Sector General Permit (MSGP) for Industrial Activities.

5. Oil and Grease

The Draft Permit contains a daily maximum limit of 15 mg/l for Outfall 003 as continued from the Expired Permit, in accordance with anti-backsliding regulations as defined at 40 CFR §122.44(l). This limit was based on the Massachusetts Surface WQSs, 314 Code of Massachusetts Regulations ("CMR") 4.05(3)(b)(7), which state: *These waters shall be free from oil, grease and petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course, or are deleterious or become toxic to aquatic life.* The limit of 15 mg/l is recognized as the concentration at which many oils produce a visible sheen and/or cause and undesirable taste in fish (EPA Water Quality Criteria, 1972).

6. Nitrate plus Nitrite (Nitrogen)

The Draft Permit contains monitoring requirements for total nitrogen at Outfall 001 as a BPJ consideration of the MSGP requirements. Sector C, Chemical and Allied Products Manufacturing and Refining, of the 2008 final MSGP applies to the stormwater discharges from TRT. This sector contains monitoring requirements and benchmark concentrations for nitrate plus nitrite (Nitrogen). The benchmark concentration for this parameter is 0.68 mg/l. In the MSGP, this concentration is not an effluent limitation, but rather an indication of the effectiveness of the facility Storm Water Pollution Prevention Plan (SWPPP – see Part VI.D.8.). If the average concentration of four (4) samples exceeds the benchmark concentration, the Draft Permit requires the permittee to review the selection, design, installation, and implementation of all best management practices (BMPs) and control measures in the SWPPP.

7. Total Recoverable Zinc

The Draft Permit contains monitoring requirements for total recoverable zinc at Outfall 001 based on BPJ and considering the MSGP requirements. Sector C, Chemical and Allied Products Manufacturing and Refining, of the 2008 final MSGP contains monitoring requirements and benchmark concentrations for total zinc. The MSGP benchmark concentrations are for discharges to freshwater, while the discharges from TRT are to a saltwater estuary. Therefore, the Draft Permit benchmark concentration for total recoverable zinc is 0.095 mg/l, based on the National Recommended Water Quality Criteria for discharges to saltwater. This concentration is not an effluent limitation, but rather an indication of the effectiveness of the facility SWPPP (see Part VI.D.8.). If the average concentration of four (4) samples exceeds the benchmark concentration, the Draft Permit requires the permittee to review the selection, design, installation, and implementation of all BMPs and control measures in the SWPPP.

8. Storm Water Pollution Prevention Plan (SWPPP)

This facility engages in activities which could result in the discharge of pollutants to waters of the United States either directly or indirectly through stormwater runoff. These operations include at least one of the following in an area potentially exposed to precipitation or stormwater: material storage, in-facility transfer, material processing, material handling, or loading and unloading. To control the activities/operations, which could contribute pollutants to waters of the United States, potentially violating the State's Water Quality Standards, the Draft Permit requires the facility to develop, implement, and maintain a Stormwater Pollution Prevention Plan (SWPPP) documenting the application of best management practices (BMPs) appropriate for this specific facility (See Sections 304(e) and 402(a)(1) of the CWA and 40 CFR §122.44(k)).

The goal of the SWPPP is to reduce, or prevent, the discharge of pollutants through the stormwater system. The SWPPP serves to document the selection, design and installation of control measures, including BMPs. Additionally, the SWPPP requirements in the Draft Permit are intended to facilitate a systematic approach for the permittee to properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. The SWPPP shall be prepared in accordance with good engineering practices and identify potential sources of pollutants, which may reasonably be expected to affect the quality of stormwater discharges associated with industrial activity from the facility. The SWPPP documents the appropriate best management practices (BMPs) implemented or to be implemented at the facility to satisfy the non-numeric technology-based effluent limitations included in the Draft Permit. These non-numeric effluent limitations support, and are equally enforceable as, the numeric effluent limitations included in the Draft Permit.

Development and implementation of the SWPPP involves the following four main steps:

(1) Forming a team of qualified facility personnel who will be responsible for developing and updating the SWPPP and assisting the plant manager in its implementation;
(2) Assessing the potential stormwater pollution sources;
(3) Selecting and implementing appropriate management practices and controls for these potential pollution sources; and
(4) Reevaluating, periodically, the effectiveness of the SWPPP in preventing stormwater contamination and in complying with the various terms and conditions of the Draft Permit.

VII. Cooling Water Intake Structure and Thermal Discharge, CWA Sections 316(a) and 316(b)

A. 316(a): Variance to Allow Thermal Discharge

The state classification for the Town River Bay is Class SB. Thus, WQSs require that the in-stream water temperature shall not exceed an instantaneous maximum of 85 ºF nor a daily mean of 80 ºF. In addition, the rise in temperature due to discharge shall not exceed 1.5 ºF during the summer months (July through September) nor 4 ºF during the winter months (October through June). Based on the historical data presented in Attachment B, the thermal discharge from the facility has never exceeded the maximum in-stream water quality criteria but has exceeded WQSs regarding rise in temperature when comparing the effluent temperature (which has already experienced mixing with the receiving water) with ambient temperature data. Additionally, the discharge temperature has exceeded ambient temperatures recorded by MWRA in Hingham Bay (see Appendix D), which are expected to be similar to, though not necessarily the same as, the ambient temperatures in the Town River Bay.

According to CWA § 316(a), as codified at 40 CFR 125 subpart H, thermal discharge effluent limitations in permits may be less stringent than those required by applicable standards and limitations if the discharger demonstrates that such effluent limitations are more stringent than necessary to assure the protection and propagation of a balanced, indigenous population (BIP) of shellfish, fish and wildlife in and on the body of water into which the discharge is made. This demonstration must show that the alternative effluent limitation desired by the discharger, considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected, will assure the protection and propagation of the BIP in and on the body of water into which the discharge is made.

In TRT's Response to EPA's Section 308 Request, the facility requested a thermal variance for "…a maximum temperature of 95ºF measured at the discharge point of Outfall 003, with no delta T requirements at the discharge point at low tide when the mud flat is exposed." The facility states that these limits would "…assure the protection and propagation of [the BIP] in and on the body of water into which the discharge is to be made." In support of this claim, TRT has presented data regarding the species present in the tidal mud flat and the thermal tolerances of those species. Based on an aquatic ecology study for the proposed Edgar Energy Park Project (MRI 1992), TRT states that the most prevalent species in the area are Atlantic silverside, the soft-shell clam, and the mummichog. According to information submitted by the facility, the upper limit of the thermal tolerances of these species ranges from 88ºF[1], to 93.9ºF[2], to 107.6ºF[3], respectively.

The Draft Permit denies the request for a variance-based thermal effluent limit of 95ºF because it is greater the upper thermal tolerance of the Atlantic silverside, 88ºF, and the thermal tolerance of the soft-shell clam, 93.9 ºF, and therefore may not be protective of the BIP in the Town River. Instead, the Draft Permit includes an instantaneous maximum limit of 87ºF. EPA is establishing this limit as a water quality-based limit when Outfall 003 is submerged and an alternative variance-based limit when Outfall 003 discharges to the tidal mud flats (see explanation below). Additionally, the Draft Permit grants TRT's request for a variance-based thermal effluent limit of no delta T requirements when the discharge is to the tidal mud flats.

When Outfall 003 is not submerged in the Town River Bay, the discharge is to a tidal mud flat and thus receives no initial dilution from the receiving water. Species present in the tidal mudflat, such as the soft-shell clam, have high thermal tolerances to survive periods when they are not submerged in the water. The alternative variance-based limit of 87ºF is protective of

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1 Fay, C.W., R.J. Neves, and G.B. Pardue. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) – Atlantic silverside. U.S. Fish and Wildlife Service, Division of Biological Sciences, FWS/OBS-82/11.10 U.S. Army Corps of Engineers, TR EL-82-4. 15pp

2 Newell, C.R., and H. Hidu. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) – soft shell clam. U.S. Fish and Wildlife Ser. Biol. Rep. 82(11.53). U.S. Army Corps of Engineers, TR EL-82-4.17pp.

3 Abraham, B.J. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic) – Mummichog and striped killifish. U.S. Fish and Wildlife Serv. Biol. Rep. 82(11.40). U.S. Army Corps of Engineers, TR EL-82-4. 23pp.

these species because it is below the thermal tolerances of the species present in the receiving water. Additionally, the requested variance-based limit of no delta T requirements is protective of these species because they have adapted to survive large temperature changes. Once the discharge flows beyond the mud flat, it is still protective of the BIP, as evidenced by the thermal tolerance of the Atlantic Silverside. Additionally, at this point the discharge will receive dilution from the Town River Bay, and temperatures in the Town River Bay will decrease. Therefore, based on the thermal tolerance of the species in the Town River Bay, the Draft Permit alternate variance-based thermal effluent limits for a maximum discharge temperature of 87 ºF and no delta T requirements, when Outfall 003 discharges to the tidal mud flats, are protective of the BIP.

When Outfall 003 is submerged in the Town River Bay, the discharge will receive dilution from the receiving water. The dilution calculations presented in Appendix D compare the historic discharge temperature to ambient temperature data collected by MWRA buoy number 124, located in Hingham Bay, and approximate the volume and surface area of the mixing zone required to meet Massachusetts WQS. In the winter, assuming the highest permitted discharge temperature and volume, the lowest ambient temperature, and an allowable rise in temperature of 4 ºF, the mixing zone represents only approximately 4% of a conservative estimate of the available dilution in the Town River Bay. In the summer, Massachusetts WQS only allow a rise in temperature of 1.5 ºF, but the mixing zone still only represents 4% of the available dilution. Additionally, the estimated area of the mixing zone is 437,738.05 square feet in the winter and 475,419.44 square feet in the summer, which is not expected to exceed 50% of the width of the channel at the mouth of the Town River Bay and thus provides a zone of passage. The Draft Permit requires TRT to complete an Ambient Temperature and Mixing Zone Study to confirm the location of the mixing zone during all tidal conditions and to ensure that the discharge meets WQS, with the establishment of the mixing zone. Based on the available dilution, when Outfall 003 is submerged not only is the discharge temperature protective of the BIP in the Town River Bay both in and beyond the mixing zone, but the discharge also meets Massachusetts WQS for temperature and application of a mixing zone of limited area or volume.

B. 316(b): Determination of Best Technology Available (BTA) for Cooling Water Intake Structures (CWIS)

With any NPDES permit issuance or reissuance, EPA is required to evaluate or re-evaluate compliance with applicable standards, including the technology standard specified in Section 316(b) of the CWA for cooling water intake structures (CWIS). Section 316(b) requires that:

> [a]ny standard established pursuant to section 301 or section 306 of this Act and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.

33 U.S.C. § 1326(b). The operation of CWISs can cause or contribute to a variety of adverse environmental effects, such as killing or injuring fish larvae and eggs entrained in the water withdrawn from a water body and sent through the facility's cooling system, or by killing or injuring fish and other organisms by impinging them against the intake structure's screens.

CWA § 316(b) applies if a point source discharger seeks to withdraw cooling water from a water of the United States through a CWIS. CWA § 316(b) applies to this permit due to the presence and operation of a CWIS at the TRT facility.

1. Introduction and Regulatory Background

The CWA requires that NPDES permits include limits and conditions necessary to meet applicable federal technology-based standards and any more stringent limits required by state water quality standards or other state law requirements. *See* 33 U.S.C. §§ 1311(b), 1341(a)(1) and (d), 1342(a), and 1370; 40 C.F.R. §§ 122.43(a) and 122.44. In other words, federal technology-based standards represent the minimum level of pollution control to be required by an NPDES permit. Therefore, an NPDES permit issued to a facility with CWISs should include limits reflecting the "best technology available for minimizing adverse environmental impacts" (BTA) under CWA § 316(b), *see* 40 C.F.R. §§ 122.44(b)(3) and 401.14, and any applicable, more stringent water quality standards. *See* 40 C.F.R. §§ 122.4(d) and 122.44(d). *See also* 40 C.F.R. §§ 125.80(d) and 125.84(e) (CWIS requirements for new facilities must comply with any more stringent, applicable state water quality standards). In the absence of national categorical standards under § 316(b), EPA has, for many years, applied the provision on a case-by-case, best professional judgment (BPJ) basis for both new and existing facilities.

In December 2001, EPA promulgated final regulations under § 316(b) that provide specific categorical technology-based requirements for all types of *new* facilities with CWISs, except for new offshore oil and gas extraction facilities. 40 C.F.R. Part 125, Subpart I (Phase I rule or Phase I regulations). The Phase I rule does not apply to TRT because it is not a new facility, as defined in 40 CFR Section 125.83.

On July 9, 2004, EPA published final regulations that set national categorical standards under § 316(b) for *large*, *existing* power plants (Phase II rule or Phase II regulations). *See* 69 Fed. Reg. 41576 (July 9, 2004) (codified at 40 CFR Part 125, Subpart J). On July 9, 2007, EPA formally suspended the Phase II rule, except for § 125.90(b), which provides that "[e]xisting facilities that are not subject to [CWIS] requirements under [Part 125] must meet requirements under section 316(b) of the CWA determined by the Director on a case-by-case, BPJ basis." 72 Fed. Reg. at 37108. At this time, EPA is continuing to make § 316(b) determinations for large, existing power plants on a case-by-case, BPJ basis. However, the Phase II rule does not apply to TRT because it is not a large, existing power plant.

On June 16, 2006, EPA published the Phase III rule as the third and final phase of regulations under § 316(b) of the CWA. This rule determined how § 316(b) would be applied to facilities not governed by the Phase I or Phase II rules (*i.e.*, smaller existing power plants, all sizes of existing, non-power plant facilities with CWISs, and new offshore oil and gas extraction facilities). In promulgating the Phase III Rule, EPA decided to develop categorical standards only for new offshore oil and gas extraction facilities that have a design intake flow threshold of greater than 2 million gallons per day (MGD), and to continue to address the other facilities on a case-by-case, BPJ basis. TRT, an existing manufacturing plant, is defined as an existing Phase III facility under the Phase III rule and, as such, is subject to permitting requirements under § 316(b) as applied on a case-by-case, BPJ basis.

Neither the CWA nor EPA regulations dictate a specific methodology for developing BPJ-based limits under § 316(b). What is clear, however, is that the elements specified in the statute—namely, that the design, location, capacity and construction of CWISs must reflect the best technology available for minimizing the adverse impacts—must be satisfied.[4]

EPA has read CWA § 316(b) to intend that entrainment and/or impingement should be regarded as an "adverse impact" that must be minimized through the application of the BTA, but this might or might not require the complete elimination of all such impacts in a given case. EPA also looks by analogy to the factors considered in the BPJ development of BAT effluent limits under both the CWA and EPA regulations for guidance regarding additional factors to be considered in making a BTA determination under CWA § 316(b). In setting *BAT* effluent limitations on a BPJ basis, EPA considers various factors specified in the statute, *see* 33 U.S.C. §§ 1311(b)(2)(A) and 1314(b)(2), and in 40 C.F.R. § 125.3(d)(3).[5] These factors are: (1) the age of the equipment and facilities involved, (2) the process employed, (3) the engineering aspects of applying various control techniques, (4) process changes, (5) cost, and (6) non-water quality environmental impacts (including energy issues). According to 40 C.F.R. § 125.3(c)(2), a BPJ-based BAT analysis also should consider the "appropriate technology for the category of point sources of which the applicant is a member, based on all available information," and "any unique factors relating to the applicant." As indicated above, the permit writer developing BAT limits on a site-specific, BPJ basis applies the same performance-based approach to an individual point source that EPA applies to whole categories and classes of point sources when it develops ELGs.[6]

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4 Thus, a proper determination based on a BPJ analysis results in a valid, facility-specific BTA determination. In NRDC v. EPA, 859 F.2d 156, 199 (D.C. Cir. 1988) (industry and environmental group challenge to 1979 revisions to NPDES regulations, including the ban on backsliding from BPJ limits), the court explained:

> [i]n what EPA characterizes as a 'mini-guideline' process, the permit writer, after full consideration of the factors set forth in section 304(b), 33 U.S.C. § 1314(b) (which are the same factors used in establishing effluent guidelines), establishes the permit conditions 'necessary to carry out the provisions of [the CWA].' § 1342(a)(1). These conditions include the appropriate ... BAT effluent limitations for the particular point source. ... [T]he resultant BPJ limitations are as correct and as statutorily supported as permit limits based upon an effluent limitations guideline.

Id. See also Texas Oil & Gas Ass'n v. EPA, 161 F.3d 923, 929 (5th Cir. 1998) ("Individual judgments thus take the place of uniform national guidelines, but the technology-based standard remains the same.").

5 See also NRDC v. EPA, 863 F.2d at 1425 ("in issuing permits on a case-by-case basis using its 'Best Professional Judgment,' EPA does not have unlimited discretion in establishing permit limitations. EPA's own regulations implementing [CWA § 402(a)(1)] enumerate the statutory factors that must be considered in writing permits.").

6 See, e.g., Texas Oil & Gas Ass'n, 161 F.3d at 929 (under 40 C.F.R. § 125.3, "EPA must determine on a case-by-case basis what effluent limitations represent the BAT level, using its 'best professional judgment.' Individual judgments thus take the place of uniform national guidelines, but the technology-based standard remains the same.") (citation omitted); NRDC v. EPA, 859 F.2d at 201('in establishing BPJ limits, EPA considers the same statutory factors used to establish national effluent guidelines. BPJ limits thus represent the level of technology control mandated by the CWA for the particular point source."); Trustees for Alaska v. EPA, 749 F.2d 549, 553 (9th Cir. 1984) (EPA must consider statutorily enumerated factors in its BPJ determination of effluent limits); USEPA NPDES Permit Writer's Manual (1996) at 69-70. See also NRDC v. EPA, 863 F.2d at 1425 ("courts reviewing permits issued on a BPJ basis hold EPA to the same factors that must be considered in establishing the national effluent limitations" (citations omitted)).

Because a BPJ-based application of CWA § 316(b)'s BTA standard is conducted on a case-by-case, site-specific basis, EPA must also consider whether the technologies under consideration are truly practicable (or feasible) for use at the particular manufacturing facility in question. In other words, although a technology works at one manufacturing facility, it might not actually be feasible at another facility due to site-specific issues (*e.g.,* space limitations). Accordingly, a technology that works at another facility but is not actually feasible at TRT would not be the BTA for this permit.

Again turning for guidance to the process for devising BPJ-based BAT limits, EPA regulations for BAT direct the Agency to consider "unique factors relating to the applicant." 40 C.F.R. § 125.3(c)(2). This parallels the above-described site-specific evaluation that EPA conducts in its BPJ application of CWA § 316(b).

As noted earlier, in developing BAT limits on a BPJ basis, EPA also considers the six statutory factors for developing BAT effluent limitations: (1) the age of the equipment and facilities involved, (2) the process employed, (3) the engineering aspects of applying various control techniques, (4) process changes, (5) cost, and (6) non-water quality environmental impacts (including energy issues). *See* USEPA NPDES Permit Writer's Manual (1996) at 70. The CWA sets up a loose framework for assessing these statutory factors in setting BAT limits.[7] It does not require their comparison, merely their consideration.[8] "[I]n enacting the CWA, 'Congress did not mandate any particular structure or weight for the many consideration factors. Rather, it left EPA with discretion to decide how to account for the consideration factors, and how much weight to give each factor.'"[9]

In sum, when EPA considers the statutory factors in setting BAT limits, it is governed by a standard of reasonableness.[10] It must consider each factor, but it has "considerable discretion in evaluating the relevant factors and determining the weight to be accorded to each in reaching its ultimate BAT determination."[11] One court has succinctly summarized the standard for judging EPA's consideration of the statutory factors in setting BAT effluent limits: "[s]o long as the required technology reduces the discharge of pollutants, our inquiry will be limited to whether

7 *BP Exploration & Oil, Inc.*, 66 F.3d at 796; *Weyerhauser v. Costle*, 590 F.2d 1011, 1045 (D.C. Cir. 1978) (citing Senator Muskie's remarks on CWA § 304(b)(1) factors during debate on CWA). *See also EPA v. Nat'l Crushed Stone Ass'n*, 449 U.S. 64, 74, 101 S.Ct. 295, 300, 66 L.Ed.2d 268 (1980) (noting with regard to BPT that "[s]imilar directions are given the Administrator for determining effluent reductions attainable from the BAT except that in assessing BAT total cost is no longer to be considered in comparison to effluent reduction benefits").

8 *Weyerhauser*, 590 F.2d at 1045 (explaining that CWA § 304(b)(2) lists factors for EPA "consideration" in setting BAT limits, while CWA § 304(b)(1) lists both factors for EPA consideration and factors for EPA "comparison" -- *e.g.*, "total cost versus effluent reduction benefits" -- in setting BPT limits).

9 *BP Exploration & Oil, Inc.*, 66 F.3d at 796; *Weyerhauser v. Costle*, 590 F.2d at 1045.

10 *BP Exploration & Oil*, 66 F.3d at 796; *Am. Iron & Steel Inst. v. EPA*, 526 F.2d 1027, 1051 (1975), *modified in other part*, 560 F.2d 589 (3d Cir. 1977), *cert. denied*, 435 U.S. 914 (1978).

11 *Texas Oil & Gas Ass'n*, 161 F.3d at 928; *NRDC v. EPA*, 863 F.2d at 1426. *See also Weyerhauser*, 590 F.2d at 1045 (discussing EPA's discretion in assessing BAT factors, court noted that "[s]o long as EPA pays some attention to the congressionally specified factors, the section [304(b)(2)] on its face lets EPA relate the various factors as it deems necessary").

the Agency considered the cost of technology, along with other statutory factors, and whether its conclusion is reasonable."[12]

Using the process for developing BAT limits as guidance, EPA has also considered the six statutory BAT factors in determining the BTA-based limits under CWA § 316(b) for this draft permit. EPA's site-specific evaluation of the relevant factors for TRT is presented in Section VII.B.3(b) of this Fact Sheet.

State legal requirements, including state WQSs, also may apply to the development of permit conditions for CWISs. State WQSs set designated uses for water bodies within the State and specify narrative and numeric criteria that the water bodies must satisfy. The limits in EPA-issued NPDES permits that address CWISs must satisfy both CWA § 316(b) and any applicable State requirements, such as appropriate WQSs [See CWA §§ 301(b)(1)(C), 401(a)(1) and (d), and 510; 40 CFR §§ 122.4(d), 122.44(d), 125.84(e), and 125.94(e); 314 CMR 4.00]. MassDEP has primary responsibility for determining what permit limits are necessary to achieve compliance with State law requirements. Since the NPDES permit that EPA expects to issue to TRT will be subject to State certification under CWA § 401, the permit will also need to satisfy any MassDEP conditions of such a certification (See also 40 CFR §§ 124.53 and 124.55). EPA anticipates that MassDEP will provide this certification before the issuance of the final permit.

2. Biological Impacts

Section 316(b) of the CWA addresses the adverse environmental impact of cooling water intake structures (CWIS) at facilities requiring NPDES permits. Adverse environmental impacts from CWISs result from the entrainment of fish eggs and larvae and other small forms of aquatic life through the plant's cooling system and from the impingement of fish and other larger forms of aquatic life on the intake screens. Entrainment and impingement can contribute to reductions of local species of commercial and/or recreational importance, locally important forage species, and local threatened or endangered species.

A site-specific fish survey has not been conducted by the permittee in the vicinity of the intake structure. In addition, the permittee has not monitored its CWIS for the number and species of fish impinged to date. However, TRT does note several previous studies conducted near the facility and/or that are pertinent to the cooling water intake/discharge structures. These studies include a 1993 study of the aquatic ecology of the Weymouth Fore River (MRI-Normandeau), a 1997 study regarding revitalizing the Fore River (Mass. Bays Program), a 1999 fisheries study related to the Fore River Power Station (MRI-Normandeau), a 2001 study of the rainbow smelt spawning habitat in the Weymouth Fore River (Massachusetts Division of Marine Fisheries), and a 2006 impingement and entrainment biomonitoring study at Mystic Station (Shaw). Mystic

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12 *Ass'n of Pacific Fisheries v. EPA*, 615 F.2d 794, 818 (9th Cir. 1980) (industry challenge to EPA regulations implementing BAT limits for seafood processing industry point sources). *See also Chemical Manufacturers Ass'n (CMA) v. EPA*, 870 F.2d 177, 250 n.320 (5th Cir. 1989), *citing* Congressional Research Service, *A Legislative History of the Water Pollution Control Act Amendments of 1972* at 170 (1973) (hereinafter "*1972 Legislative History*") (in determining BAT, "'[t]he Administrator will be bound by a test of reasonableness.'") (industry challenge to EPA regulations implementing BAT limits for organic chemicals, plastics and synthetic fibers industry point sources); *NRDC v. EPA*, 863 F.2d at 1426 (same); *American Iron & Steel Inst.*, 526 F.2d at 1051 (same).

Station is located in Charlestown, MA and discharges to the Boston Harbor watershed, which contains substantially similar species as the Weymouth Fore River.

According to the aquatic ecology study of the Weymouth Fore River, as submitted by the permittee, ichthyoplankton exhibits two seasonal periods of peak abundance; a peak larval abundance in March and a peak egg abundance from May to September. The peak abundance of larvae during March was primarily comprised of rock gunnel and sandlance, while tautog/cunner eggs, overall the most abundant ichthyoplankton sampled, comprised the majority of the ichthyoplankton density during the summer months. Fourspot flounder/windowpane eggs were also relatively abundant in the summer period, and rainbow smelt larvae were particularly abundant during May. The study collected a diverse assemblage of finfish species by trawl, gill net, and beach seine typical of New England estuarine habitat, and including winter flounder, rainbow smelt, Atlantic tomcod, windowpane flounder, little skate, grubby, Atlantic menhaden, alewife, and Atlantic silverside.

In addition, the 1997 study of the Fore River by the Massachusetts Division of Marine Fisheries (MA DMF) identified five major shellfish beds corresponding with tidal mudflats. According to TRT, none of these shellfish beds have been open for harvest on an unrestricted basis since the 1970's. MA DMF confirms this information, but states that shellfishing is still permitted and does occur in the Germantown section of the bay under conditional closure.13 Based on the 2001 study of the rainbow smelt spawning habitat, the permittee describes the Weymouth Fore River as one of the largest smelt runs in Massachusetts. Spawning has been observed to occur during early March through late May and is limited to the upper reaches of the estuary and its tributaries.

a. Entrainment

Entrainment of organisms occurs when water is withdrawn by a facility into the CWIS from an adjacent water body. Eggs and larvae are typically small enough to pass through the mesh of the intake screens and become entrained within the facility. As a result, the eggs and larvae are exposed to shear forces from mechanical pumps, physical stress or injury, elevated temperatures from waste heat removal, and, in some cases, high concentrations of chlorine or other biocides. These organisms can be killed or otherwise harmed as a result of entrainment. The extent of entrainment of fish and invertebrates in CWISs is determined by several factors, including the nature of the water body in which the CWIS is located, the particular location in the water body in which the intake structure is placed, the biological community present in the water body, the volume and velocity of the intake flow, the nature of any intake screening system or other entrainment reduction equipment used by the facility, and season. The number of organisms that become entrained is dependent upon the flow of cooling water through the plant and the concentration of organisms in the source water body that are small enough to pass through the screens of the plant's intake structure(s). Given the nature of the entrainment process and the vulnerabilities of the organisms being entrained, EPA assumes 100% mortality of entrained organisms in order to determine adverse environmental impacts to local fish and invertebrate

13 Personal Communication with Jack Schwartz, Massachusetts Division of Marine Fisheries June 23. 2009.

populations, unless a permittee provides a site-specific study justifying use of a lower mortality rate. See 69 FR 41620 (July 9, 2004).

In the 2006 impingement and entrainment monitoring at Mystic Station, the most abundant larval species in entrainment samples were grubby and sand lance. Other commonly entrained species included Atlantic menhaden larvae, Atlantic tomcod larvae, cunner/tautog-yellowtail flounder eggs, rock gunnel larvae, and winter flounder larvae. The majority of egg entrainment occurred from early April to the end of July whereas the majority of larval entrainment occurred from early February to mid April, with another peak in mid-May and mid-June. Species entrained at Mystic Station and at other coastal New England CWISs (e.g., Wheelabrator Saugus, General Electric Lynn, Mirant Canal Station) are also present in the Weymouth Fore River. Therefore, EPA concludes that TRT has the potential to entrain a substantial number of fish eggs and larvae and that under CWA § 316(b), the design, location, construction and capacity of TRT's cooling water intake structure must reflect the Best Technology Available for minimizing these adverse impacts.

b. Impingement

Impingement of organisms occurs when water is drawn into a facility through its CWISs and organisms too large to pass through the protective screens and unable to swim away become trapped against the screens and other parts of the intake structure. The quantity of organisms impinged is a function of the intake structure's location, its depth, the velocity of water at the entrance of the intake structure and through the screens, the seasonal abundance of various species of fish, and the size of various fish relative to the size of the mesh in any intake barrier system (e.g., screens). While adults are susceptible to impingement, juvenile fish are generally weaker swimmers and tend to become impinged more often and in greater numbers than adults. Injury to fish, including descaling, exhaustion, asphyxiation and starvation may occur due to impact against the screens over the intake structure.

In the 2006 impingement and entrainment monitoring at Mystic Station, the most abundant species in the impingement samples were blueback herring and Atlantic menhaden. Other commonly impinged species included grubby, rainbow smelt, winter flounder, and Atlantic herring. The majority of impingement occurred from mid-November through the end of January, with another peak in September. The species vulnerable to impingement at Mystic Station and other coastal New England CWISs are also common the Weymouth Fore River (1993 study). The permittee, in the Response Document to EPA's 308 Request, maintains that the potential for impingement is low given that "impingement appears to be negligible based on observations when screens are removed" (p.30) and "most fish would be able to overcome the low intake velocity of the CWIS at TRT and never become impinged" (p.66). The ½-inch intake screens on which organisms would become impinged are removed from the water and manually cleaned approximately once a year. EPA would not expect to see evidence of impingement on screens observed once per year after being withdrawn through the water, and does not consider this observation a reasonable indication that impingement is not occurring. Additionally, Mirant Kendall Station regularly observes impingement with an intake velocity comparable to that of TRT, at times as high as 2,000 fish per day. The intake velocity at TRT is not low enough for EPA to conclude that no reasonable potential for impingement exists. In the absence of facility-specific impingement monitoring records, EPA concludes that TRT has the potential to impinge a substantial number of adult and juvenile fish and that under CWA § 316(b), the design, location, construction and capacity of TRT's cooling water intake structure must reflect the Best Technology Available for minimizing these adverse impacts.

c. Summary: Entrainment and Impingement

TRT withdraws approximately 5 MGD of water from the Weymouth Fore River. EPA estimates that approximately 5.3 million eggs and 1.3 million larvae per year could be entrained based on values provided by the permittee. In addition, EPA estimates that a number of adult and juvenile individuals are impinged, although the number is not known. The design, location, construction and capacity of TRT's CWIS must reflect the BTA for minimizing these adverse impacts. The benefits of such technologies are reductions in mortality of aquatic organisms, which will directly benefit fish species of commercial and recreational importance, as well as help to preserve populations of forage fish, invertebrates, and the overall biological diversity of the estuary. In turn, improvements to the River's aquatic life will benefit populations of birds and other terrestrial animals dependent on the salt marsh habitat; enhance recreational opportunities, including bird-watching, fishing and canoeing; and promote the preservation of the Weymouth Fore River. Technology to minimize impingement and entrainment will also benefit rainbow smelt, a species with declining populations for which the Weymouth Fore River provides on of the largest spawning runs in the state. The potential components of BTA are assessed below.

3. Components of BTA for Twin Rivers Technologies US Inc.

As stated above, CWA § 316(b) requires "that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." TRT maintains that the facility is already in compliance with CWA § 316(b) based on the 2002 NPDES permit, and that no further action by the permittee is required during this reissuance. In the following section, EPA evaluates the existing and available technologies and makes a BTA determination for the Draft Permit based on BPJ with consideration of the BAT factors.

a. Location

The location of a CWIS in the waterbody is an important factor in minimizing its adverse environmental impacts. EPA evaluated the location of the CWIS in the waterbody, the type of waterbody, and the depth of the intake structure to determine how to best minimize adverse environmental impacts under CWA § 316(b).

The CWIS at TRT is located in the Weymouth Fore River, approximately 300 feet from the confluence with the Town River. This highly productive estuarine habitat offers valuable spawning and nursery areas, extensive salt marsh, shellfish beds, and tidal flats that support a diverse assemblage of aquatic organisms as well as plants, birds, and other wildlife species. The Weymouth Back River, at the head of the tide, was designated an area of critical environmental concern (ACEC) by the Massachusetts Department of Conservation and Recreation in 1982. In addition, the estuary upstream of the facility provides extensive spawning habitat for rainbow smelt (Chase and Childs 2001).

As described in Part VI.B of this Fact Sheet, TRT's intake structure is located 11.35 feet below the surface at mean lower low water (MLLW) and 25.5 feet below the existing boat dock. Below the intake structure, the river bottom contours downward for another 22 feet, at a slope of 3:1, to reach a final depth of 33 feet. The elevation of the intake structure, 22 feet above the bottom of the river, decreases the potential of the CWIS to impinge benthic or near benthic organisms such as the soft-shell clam and juvenile or adult winter flounder. The mid-depth location may also minimize the potential for entrainment of buoyant eggs, such as cunner/tautog or four-spot flounder/windowpane, both of which are found in high abundance in the river, as well as demersal eggs such as those of grubby and winter flounder.

TRT's CWIS is also located approximately 75 feet from a 550-foot wide navigation channel, which is dredged by the Army Corps of Engineers (ACOE). All sites of the TRT perimeter along the Weymouth Fore River have approximately the same depth profiles and are located approximately equidistant from the navigation channel. Additionally, productive shellfish beds and spawning grounds for rainbow smelt as well as a designated ACEC, are located further upstream from the TRT CWIS. Therefore, relocating the CWIS to another location on the Weymouth Fore River or Town River Bay may not be available due to conflicts with valuable habitat and/or the navigational channel, and, particularly if relocated upstream towards rainbow smelt spawning habitat, may increase adverse impacts.

Based on this evaluation, EPA concludes that no alternative CWIS location is available that would better minimize adverse impacts more than the existing CWIS location and mid-depth profile. The Draft Permit requires that any proposed change in the location, design, or capacity of the intake structures must be approved in reported to EPA, and may be subject to a permit modification. This will ensure that the permittee maintains the existing mid-depth intake location to minimize adverse impacts from impingement and entrainment. Still, the habitat in which the CWIS is located is a productive estuary with a high density of ichthyoplankton, juvenile, and adult aquatic species. As such, the potential for impingement and entrainment is high and the design, construction, and operation of the CWIS must sufficiently minimize these adverse impacts.

b. Design, Construction, and Operation of the CWIS

The design, construction, and operation of a CWIS are additional important factors in minimizing its adverse biological impacts. Fish protection technologies, including physical exclusion systems such as barrier nets or screens, can reduce impingement and entrainment impacts if properly designed, installed, and maintained.

The velocity of water entering a CWIS, or intake velocity, exerts a direct physical force against which fish and other organisms must act to avoid impingement or entrainment. As intake velocity increases at a CWIS, so does the potential for impingement and entrainment. EPA considers intake velocity to be one of the more important factors that can be controlled to minimize adverse environmental impacts at CWISs. See 65 FR 49060, 49087 (Aug. 10, 2000). EPA has identified a "through screen" velocity threshold of 0.5 feet per second (fps) as protective to minimize impingement of most species of adult and juvenile fish. This determination is fully discussed at 65 FR 49060, 49087-88.

As described above in Part IV.B., the CWIS is comprised of two intake tunnels that each contain two intake pipes (for a total of four pipes). These pipes are covered by ½ inch mesh screens and converge two feet beyond the screen to a single intake manifold. Although the CWIS contains four pumps, with a total design capacity of 10.6 MGD, TRT only utilizes two of these pumps at any given time for a total intake capacity of 5 MGD. Using this discharge rate and the cross sectional area of four of the intake pipes, approximately 19.64 square feet, TRT has an estimated through-screen velocity (TSV) of 0.738 fps. This TSV is greater than 0.5 fps, the intake velocity identified as protective in the Phase I Final Rules, and therefore has the potential to impinge organisms on the fixed screens. See 66 FR 65274. If TRT were to utilize the total design capacity of the pumps, 10.6 MGD, the TSV at the CWIS would be 1.569 fps. The TSV at the facility is higher than the level considered protective by EPA and, unlike more common rotating screens that incorporate a fish return system, TRT's intake screens have no mechanism to remove impinged fish. As a result, there is potential for high mortality of fish at TRT due to impingement. Therefore, the existing intake screens are not the BTA for this facility at this time.

To minimize the potential for impingement mortality at the CWIS, the TSV must be 0.5 fps or less. A physical barrier larger than the existing screens could reduce the TSV to acceptable levels for minimizing impingement. At EPA's request, TRT evaluated the feasibility of installing different screen technologies at the facility to reduce adverse environmental impacts, including Ristroph traveling screens, wedgewire screens, barrier nets, and aquatic filter barriers (AFBs). The facility has utilized a fixed screen design since the construction of the CWIS in 1904, and the current screens, consisting of the 6 inch bar racks and ½ inch mesh screens, are approximately 10 years old. Many advances in fish screening technologies have occurred since this time that potentially could be installed at TRT. The evaluations of these technologies are summarized below.

(1) - Ristroph Traveling Screens with Coarse or Fine Mesh

Ristroph traveling screens are designed to minimize entrainment using small mesh sizes to exclude some life stages, and/or impingement mortality through the operation of a fish buckets, spray wash, and a fish return system, which promotes survival following impingement by returning organisms to the receiving water. The degree to which entrainment and impingement mortality is reduced is highly dependent on the species and life stages present in the vicinity of the CWIS. In laboratory and field studies, adults and juveniles of some tested species showed high rates of survival (92 to 100 percent) and low rates of injury following impingement on Ristroph screens, although mortality, injury, and scale loss tended to increase with longer impingement durations and higher velocities (EPRI 2006).

According to TRT, installing this technology would require the design and construction of a new intake structure and fish return system. This technology would not change the achievable thermal or flow limits at the discharge. The cost of purchasing one four foot wide dual-flow traveling screen with fish lifting buckets and ⅛ by ½ inch slot mesh suitable to minimize impingement mortality is estimated, by the facility, to be $400,000. Additional costs for designing, permitting, and constructing a new CWIS as well as operation and maintenance of the system were not estimated but would substantially increase the total cost of this technology.

EPA evaluated the dimensions of the eggs and larvae of the species most commonly found in the Weymouth Fore River system (see Table 1 below) and found egg diameters to range from 0.7 to 2.5 mm, and larval lengths to range from 0.2 to 15 mm. Coarse mesh, ⅜ inch Ristroph screens have the potential to reduce impingement but, based on the dimensions of the eggs and larvae presented in Table 1, will not reduce entrainment. Fine mesh screens, which have openings ranging from 0.5 mm to 1 mm, do have the potential to reduce both impingement and entrainment at the facility.

Table 1: Larval and Egg Dimensions for Common Species in the Weymouth Fore River

Species	Egg Diameter	Larvae Length
Atlantic silverside[1]	0.9-1.2 mm	5.5-15 mm
soft-shell clam[2]	NA	Less than 0.2 mm
Mummichog[3]	1.5-2.5 mm	4-7.7 mm
Tautog Cunner [14]	0.7-1.14 mm	2.2 mm
Rainbow Smelt [15]	1.0-1.2 mm	5-6 mm
Winter Flounder [16]	0.74-0.85 mm	2.4-3.5 mm

One disadvantage of fine mesh screens is that to achieve TSVs no greater than 0.5 fps, the surface area of the screens must increase substantially compared to coarse mesh Ristroph screens. In addition, the finer mesh is more susceptible to fouling, which, when the screens become occluded, can result in "velocity hotspots," where specific points at the screen face have a high TSV. Another disadvantage of Ristroph screens is that they depend on the impingement of organisms to be effective; in other words, Ristroph screens minimize impingement mortality, but not impingement. A juvenile fish, fish egg, or larva that becomes impinged on the traveling screen is washed into the fish return system and deposited back into the receiving water. If smaller, more fragile life stages such as eggs and larvae suffer mortality during contact with the screens, even though they were prevented from becoming entrained, an adverse environmental impact would still be associated with the CWIS. Survival of eggs and larvae on fine mesh screens is stage- and species-specific, and at least one study of species common to the Weymouth Fore River demonstrated moderate to poor survival of larvae (ESEERCO 1981). For instance, winter flounder early post-yolk sac larvae (PYSL) tended to have high mortality

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14 Auster, P.J. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North and Mid-Atlantic) – Tautog and Cunner. U.S. Fish and Wildlife Service, Division of Biological Sciences, FWS/OBS-82/11.10. U.S. Army Corps of Engineers, TR EL-82-4

15 Buckley, Jack. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – Rainbow Smelt. U.S. Fish and Wildlife Service, Division of Biological Sciences, FWS/OBS-82/11.106. U.S. Army Corps of Engineers, TR EL-82-4

16 Buckley, Jack. 1989. Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – Winter Flounder. U.S. Fish and Wildlife Service, Division of Biological Sciences, FWS/OBS-82/11.87. U.S. Army Corps of Engineers, TR EL-82-4

(greater than 65%), regardless of velocity or impingement duration, and alewife PYSL had high mortality (greater than 76%) in all tests.

EPA evaluated the availability of coarse and fine mesh traveling screens at TRT based on BAT factors. Regarding the age of the equipment, the fixed screen design has been used at TRT since the CWIS was constructed in 1904, and the current screen system is approximately 10 years old. Given its age and the improvements in technology since the existing system was installed, an upgrade to the CWIS to minimize impingement and/or entrainment is warranted. In regards to engineering feasibility, installing either coarse or fine mesh Ristroph screens would require TRT to design and install a new CWIS, traveling screen mechanism, and a fish return system. Additionally, while TRT did not estimate the size of screens suitable for this CWIS, both would be larger than the existing intake screens and, in particular, fine mesh screens require very large surface areas to achieve a TSV of 0.5 fps. Without a larger surface area, the TSV would be substantially higher due to the decrease in percent open area, which could result in high mortality of impinged eggs and larvae. A larger mesh size (e.g., 1-3 mm) would decrease the surface area required to maintain a low TSV, but would be unlikely to exclude a substantial number of eggs and larvae at TRT. Aside from the construction, installation, and increased maintenance, traveling screens would not result in any additional process changes and are expected to have almost no non-water quality environmental impact, but will require additional energy to power.

As described above, coarse mesh screens would not reduce entrainment at TRT, but could, with a fish return system, effectively minimize impingement mortality. However, while coarse mesh screens are technically feasible, they require a complete and costly overhaul of the existing CWIS. At this time, EPA does not recommend the operation of coarse mesh traveling screens at TRT because there are more cost effective options to minimize impingement mortality that do not require construction of a new CWIS. Fine mesh traveling screens containing mesh sizes of approximately 0.5 to 1 mm could potentially reduce entrainment; however, this technology is not available at TRT at this time because the screens 1) require a large surface area that may not be available given the limitations associated with the existing boat dock and 2) may not be biologically effective in that the screens may not exclude some early life stages of commonly entrained species, and those eggs and larvae that are excluded may not survive. In sum, EPA has concluded that neither coarse mesh nor fine mesh traveling screens constitute the BTA at TRT at this time.

(2) - Barrier Nets and Aquatic Filter Barrier (AFB)

Barrier net systems and aquatic filter barriers (AFBs) are passive netting systems that are anchored in front of an intake (surface to depth). These nets minimize impingement with very low TSVs (as low as 0.04 to 0.1 fps) and may reduce entrainment depending on the mesh size. Both of these systems perform best in environments with sufficient ambient current to remove debris and impinged organisms from the mesh surface. AFBs, unlike conventional barrier nets, are equipped with a compressed air system to assist is dislodging debris and impinged organisms and to help maintain the screen’s performance.

According to TRT, their CWIS would require a barrier net of approximately 174 ft^2 at a screen flow equal to 20 gpm/ft^2 and at the permitted intake rate of 5 MGD. This size barrier net would be feasible to install under the boat dock above the CWIS, although it is unknown whether the existing wharf would accommodate the net or if it would need to be dismantled and rebuilt, which would increase the overall cost of the technology. TRT notes that barrier nets are susceptible to fouling and are not generally equipped with self-cleaning mechanisms. Finer meshes, such as that required by TRT to reduce entrainment of eggs and larvae, may be more susceptible to fouling than coarse mesh. Also, this type of net is not cleaned as often as other screens (e.g., Ristroph traveling screens) because it typically must be removed from the water and cleaned manually. Therefore, a fine mesh barrier net, such as that needed to reduce entrainment at TRT, may result in fouling buildup leading to maintenance issues and velocity hotspots with TSVs higher than 0.5 fps at some points in the net. Conventional barrier nets with a low TSV and larger mesh sizes would minimize impingement, but TRT notes that fouling may again cause maintenance issues that could decrease the effectiveness of the technology. The permittee also notes that the net may suffer damage from passing ship wakes and tidal fluxes, but barrier nets have been installed with some success in other locations with similar activity and have not been negatively impacted (e.g., Chesapeake Bay).

TRT also examined the potential use of a type of fine-mesh AFB such as the Gunderboom Marine Life Exclusion System (MLES), which includes an airburst system to dislodge debris and minimize fouling issues. This AFB is available with fine mesh sizes smaller than 0.5 mm to minimize entrainment of eggs and larvae. Installation of these technologies for entrainment reduction are limited (e.g., NYC Waterfalls exhibit, Lovett Generating Station, and Taunton Water Development Project), but results of monitoring studies suggest that the technology effectively minimizes entrainment. A biological evaluation of an AFB installed at the Lovett Generating Station on the Hudson River demonstrated overall entrainment reductions for ichthyoplankton ranging from 73% in 2004 to 92% in 2005, but a separate 2001 study indicated that AFBs are susceptible to fouling that may decrease its effectiveness, even with an airburst system[17]. Results of a laboratory study suggest that exposure to an AFB does not impact survival of eggs and larvae, and was particularly effective in reducing entrainment with high survival for eggs and larvae of robust species such as common carp and white sucker.[18]

TRT estimated the required AFB for their intake would be approximately 347 ft^2 based on a screen flow rate of 10 gpm/ft^2 at the permitted intake rate of 5 MGD. The area immediately surrounding the CWIS at TRT contains space limitations (e.g. the boat dock, the navigation channel); still, an AFB of this size may be installed under the boat dock, although it is unknown whether the existing wharf would accommodate the AFB or if it would need to be dismantled and rebuilt, which would increase overall cost of the technology.

EPA evaluated the availability of barrier nets and AFBs at TRT based on BAT factors.

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17 ASA Analysis and Communication, Inc. Gunderboom MLES Evaluation Study at the Lovett Generating Station. Results of 2004 Biological Monitoring. December 2004. Results of 2005 Biological Monitoring. January 2006. *and* Henderson, P.A., Seaby, R. M., Cailes, C., Somes, J.R. Gunderboom Fouling Studies in Bowline Pond. July 2001.

18 Black, J. Hogan, T., Allen, G., Perry, E, Zammit, K. in press. Laboratory evaluation of an aquatic filter barrier for protecting early life stages of fish at water intakes.

Regarding the age of the equipment, the fixed screen design has been used at TRT since the CWIS was constructed in 1904, and the current screen system is approximately 10 years old. Given its age and the potential advances barrier nets and AFBs offer to minimize adverse environmental impacts, and upgrade is warranted. Regarding engineering feasibility, based on the required square footage, TRT would likely be able to install these technologies without impacting the existing CWIS. The boat dock may have to be altered or rebuilt to accommodate the nets, which would increase the overall cost of the technology. The airburst system could impact the boat dock, especially if the nets are attached to the structure of the dock, but it is unknown what these impacts might be. If these technologies were installed outside of the boat dock, they have the potential of preventing access to the dock and/or impeding navigation in the channel. The addition of either of these technologies would not result in major process changes. The airburst system associated with the AFB may require additional energy power; however, this is the only expected non-water quality environmental impact of either technology. The permittee did not provide cost estimates for either technology.

While the mesh size of barrier nets commonly used in other installations is not appropriate for reducing entrainment at TRT based on the egg diameter of the species present, including winter flounder and rainbow smelt, this technology could be installed to minimize impingement through low TSVs. An AFB could minimize entrainment because a fine mesh is available to exclude eggs and larvae, and the low TSV would minimize impingement. In addition, an AFB is equipped with an airburst system to periodically remove debris and impinged organisms. Neither a barrier net nor an AFB would require the CWIS to be altered; however, both technologies are susceptible to maintenance issues associated with fouling and may require alterations to the existing boat dock. EPA has concluded that alterations to the boat dock and possible fouling issues do not warrant excluding either barrier nets or AFBs as available at TRT, and that both technologies could be one component of the BTA at this facility.

(3) - Wedgewire Screens

Wedgewire screens can be cylindrical or flat (vertical profile screen) and the slot size can be customized to minimize entrainment and/or impingement and achieve a low TSV. Small slot size (0.5 to 1 mm) wedgewire screens would be required to prevent entrainment of the small egg sizes near TRT. Cylindrical wedgewire screens with these slot sizes have been used or tested at a number of facilities, including Chalk Point Station, Charles Point Recovery Facility, Oyster Creek Nuclear Generating Station, and Arbuckle Hydroelectric Station, as well as in controlled laboratory studies (EPRI 2008). Wedgewire screens effectively exclude small eggs and larvae and generally do not result in high rates of impingement with a sufficient ambient current to aid organisms in bypassing the structure and remove debris from the screen face. In laboratory tests, ambient velocities between 0.25 and 1.0 fps effectively minimized entrainment in combination with small slot sizes (0.5 mm) and low through-slot velocities (0.5 fps).[19] TRT estimated that based on a tidal flux in the Weymouth Fore River of approximately 889.32 million gallons per tidal cycle, the maximum channel velocity is 0.77 fps. This velocity and the large tidal range (over 9 feet) are likely enough to provide sufficient sweeping flow except at slack tide.

19 Electric Power Research Institute. 2003. Laboratory Evaluation of Wedgewire Screens for Protecting Early Life Stages of Fish at Cooling Water Intakes. Technical Report No. 1005339.

TRT noted that the CWIS is susceptible to fouling, which may reduce the effectiveness of the screens. The permittee did not clarify why these screens would be more susceptible to fouling than the existing intake screens. However, wedgewire screens can be equipped with a mechanical system for dislodging debris from the screen face. These mechanisms include an air burst system that discharges a burst of compressed air, or a mechanical brush that can be programmed to sweep across the screen face. Either of these mechanical systems would likely minimize fouling at TRT. Additionally, vertical profile wedgewire screens may be less susceptible to debris loading than cylindrical screens, particularly at low TSVs.

At TRT, significant space limitations exist based on the location of the CWIS underneath the existing boat dock, which measures approximately 50 feet by 250 feet, and is less than 100 feet from the ACOE navigation channel. The dimensions of the wedgewire screen would need to be small enough that the structure could fit underneath the boat dock, and avoid impacting the dock or navigation channel. The permittee did not estimate the size of wedgewire screens required for the design flow at a TSV of no greater than 0.5 fps. Cylindrical wedgewire screens can be very large and require additional clearance on all sides equal to half the diameter of the screen, which may be constricted by the available space and navigational channel. In addition, cylindrical wedgewire screens would require retrofitting the intake pipes to connect to the new screens. The permittee did not estimate the cost of operation and installation of a cylindrical wedgewire screen.

On the other hand, a vertical profile wedgewire screen is a flat, slotted plate that would fit over the existing intake pipes and would require minimal, if any, changes to the CWIS. The profile screen could increase the surface area of the intake, thereby reducing the TSV equal to or lower than 0.5 fps. This TSV would effectively minimize impingement mortality. Also, because the screen fits close against the intake wall, interference with the navigational channel is not an issue. The slot size can be customized to minimize the potential for entrainment of species of concern. The existing screens (approximately 12.7 mm) allow entrainment of organisms smaller than about 12 mm. The Weymouth Fore River is one of the largest remaining spawning runs for rainbow smelt (a federal species of concern experiencing declining populations) and all life stages are expected to be present near TRT's CWIS. Larval smelt (approximately 7 mm) move to tidal waters in late spring after hatching in upstream spawning areas (such as the Monatiquot River).[20] Young-of-the-year rainbow smelt (ranging from 10 to 100 mm) are likely to be present between May and late fall.[21] Thus, a slot size of 10 mm or less would minimize entrainment of young-of-year rainbow smelt, and a slot size smaller than 7 mm would likely minimize entrainment of larval smelt migrating from upstream spawning areas. Although TRT did not evaluate the feasibility of a profile wedgewire screen, according to one estimate provided to EPA, a 12-foot long by 3-foot wide screen with an opening size of 3 mm slot screen and a TSV no greater than 0.5 fps would be approximately $5,000 for the screen and framework.

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20 Buckley, J. L. 1989. Species profiles: life histories and environment; requirements of coastal fishes and invertebrates (North Atlantic)- rainbow smelt. U.S. Fish and Wildlife Service Biol. Rep. 82(11.106). U.S. Army Corps of Engineers TR EL-82-4. 11 pp.

21 Personal Communication with Brad Chase of Massachusetts Division of Marine Fisheries. April 13, 2009.

Installation would increase the total cost, but overall this technology would result in a minimal expenditure to effectively minimize impingement mortality at TRT and, with a substantially smaller opening size (10 mm or less), may also prevent entrainment of young-of-year rainbow smelt that may otherwise become entrained with the existing ½-inch (12.7 mm) screens.

EPA evaluated the availability of cylindrical and vertical profile wedgewire screens at TRT based on BAT factors. Regarding the age of the equipment, the fixed screen design has been used at TRT since the CWIS was constructed in 1904, and the current screen system is approximately 10 years old. Given its age and the advances wedgewire screens offer in minimizing adverse environmental impacts, an upgrade of the existing intake is warranted. In consideration of engineering feasibility of cylindrical wedgewire screens, TRT would have to retrofit their current stationary screen, which may not be possible as the intake tunnels are located beneath an existing boat dock with limited space and access. Additionally, the existing boat dock and proximity of the ACOE navigation channel limits the space available for installation of a cylindrical wedgewire screen, which can be quite large. A vertical profile wedgewire screen, however, is feasible because it would not require major changes to the existing CWIS and would not interfere with the navigation channel. Regarding process changes, wedgewire screens would require more maintenance than the existing screens, although the extent of this maintenance depends on the type of screen and associated mechanism for debris removal and, at least for a vertical profile wedgewire screen, is anticipated to be minimal. Wedgewire screens would not have non-water quality environmental impacts. Finally, although no estimate was provided by TRT, cylindrical wedgewire screens typically have high capital and installation costs (in the millions of dollars for other, albeit larger, facilities). Vertical profile wedgewire screens would require minimal expenditure by the permittee by at least one estimate provided to EPA.[22]

Based on the above evaluation, EPA concludes that a cylindrical wedgewire screen may be feasible for implementation at TRT, but could have a high cost and, based on space limitations, require modifications to the existing boat dock. A vertical profile wedgewire screen can be installed underneath the existing boat dock with few, if any, changes to the existing CWIS and at a nominal cost to the permittee. Both types of wedgewire screen would minimize impingement mortality with a TSV no greater than 0.5 fps and the slot size could be customized to minimize entrainment for species of concern, such as rainbow smelt young-of-year. Therefore, EPA has concluded that either a cylindrical or vertical profile wedgewire screen could represent one component of the BTA for this facility.

c. Capacity

"Capacity" refers to the potential withdrawal rate for a given CWIS operating at its maximum (or design) flow rate. Capacity is another important factor that can minimize the adverse environmental impacts of a CWIS. As noted in the 316(b) Phase I regulations, the volume of water withdrawn has a direct influence on the numbers of organisms entrained, especially with regard to pelagic (free-floating) eggs and larvae (see 66 FR 65273). A reduction in water

22 Personal Communication with Simon Mosley, AFT Inc. April 13, 2009.

withdrawals, possible either through the implementation of a closed-cycle cooling system via cooling towers or a variable frequency drive (VFD), is one of the most effective methods to reduce entrainment (66 FR 65273). Reducing flow proportionally decreases entrainment by reducing the number of organisms exposed to entrainment, whereas other technologies designed to exclude organisms or deposit them away from the intake still expose eggs and larvae to the CWIS.

The intake structure at TRT has four VFD pumps with a total design capacity of approximately 10.6 million gallons per day (MGD). The facility operates two of these pumps at a time, and the Expired Permit limited maximum daily intake flow at 5 MGD. According to TRT, the permitted flow volume represents 0.30% of the estimated total tidal exchange volume between the facility and the head-of-tide (accounting for intertidal mud flats.) The use of VFD pumps limits the intake flow by automatically adjusting the speed based on the facility's need for cooling water. Subsequently, the use of VFD pumps allows the facility to maximize pump efficiency and adjust the intake volume to meet daily requirements, often less than 5 MGD under certain operating conditions. For instance, historical data indicates that the daily maximum flow rate was only 3.5 MGD more than 89% of the time from June 2003 to January 2009 (see Attachment B). The use of VFDs has the added benefit of reducing the electrical needs of the facility compared to running the pumps at full capacity year-round.

The permitted intake flow of 5 MGD and the actual historical operating flow of 3.5 MGD represent a 53% and 67% reduction from the design flow, respectively, resulting in a decrease in entrainment proportional to this capacity reduction. Based on the annual mean density of ichthyoplankton approximated by TRT from mean density at Mystic Station, operating at the permitted intake flow of 5 MGD would save approximately 7.4 million eggs and larvae per year, and operating at the actual historic flow of 3.5 MGD would save approximately 9.4 million eggs and larvae per year. While these flow reductions also reduce the through screen velocity (TSV), as discussed above in Part VII.B.3.2., the TSV at the permitted flow of 5 MGD is still higher than the level considered protective by EPA under the Phase I Rule. Thus, VFDs cannot, in this case, be considered the BTA for minimizing impingement mortality at TRT. However, EPA concludes that the use of VFD pumps to limit intake flow at 5 MGD would be one component of BTA that will reduce the capacity of the TRT CWIS and subsequently minimize entrainment.

(1) - Closed-Cycle Cooling System

Closed-cycle cooling recirculates cooling water and can reduce cooling water intake volumes up to 96 to 98 percent, in turn directly reducing the number of organisms entrained in the CWIS (66 FR 65273). To date, closed-cycle cooling is the most effective means of reducing entrainment and impingement because it dramatically reduces the volume of cooling water required (66 FR 65273).

Currently, TRT operates one closed-cycle wet mechanical draft cooling tower in addition to a non-contact seawater system. The mechanical draft cooling tower, located on the seventh floor of Building 16, has been in operation since 1998 (see Appendix C). Building 16 is a steel structure that was retrofitted from its previous use, and, according to TRT, there are no other buildings on-site with the same structural capabilities available to accommodate an additional cooling tower. The mechanical draft cooling tower is not tied to the turbine and electrical generation, but is used for specific operational processes at the plant, while the once-through seawater cooling system supports electrical generation. The cooling towers do not directly represent foregone once-through cooling water in that they do not directly replace the need for NCCW from the once-through system. Still, without the cooling towers the facility would require an additional 5.5 MGD for process water, a 53% increase over current usage, from either a municipal source or the river.

The cooling tower operates at a cold water temperature of about 85 ºF, while the once-through system operates at a cold water temperature of about 70-72 ºF (in summer). Therefore, the closed-cycle cooling system is not as efficient and does not provide the same cooling capacity as once-through cooling water from the river. According to TRT, approximately half of the load on the once-through system depends on a temperature below 72 ºF because of the approach temperature of the process water being cooled, and the cooling tower is insufficient for the cooling needs currently supplied by the once-through cooling system. TRT proposes that an additional mechanical draft cooling tower may not meet the cooling needs required by operations at the facility. The permittee did not provide a size estimate for a tower that would meet these cooling needs, and the limited ground space on site would be unlikely to accommodate a larger tower.

The construction of a second closed-cycle cooling system to supplement and/or replace the non-contact once-through system would require make-up water for the cooling towers of approximately 1 MGD, according to the permittee. This volume represents a 90% reduction from intake design flow and an 80% reduction from permitted flow. According to TRT, a new cooling tower would require installation and operation of a blowdown system to discharge cooling tower blowdown, a chemical treatment system, a second circulating water pump station to pump heated water from the condensers back up to the cooling tower fill distribution system, and possible additional retrofits to ensure that the existing piping, equipment and condenser water passages are able to handle the additional load. In addition, TRT notes that the facility has inadequate ground space on site for the cooling towers, and placement of additional towers in a building or on a roof, similar to the existing towers, may not be structurally feasible. Finally, TRT estimated that the capital expense and installation of this system would be $2.6 million with an added annual operation/maintenance expense of more than $260,000.

EPA evaluated the availability of additional mechanical draft cooling towers at TRT based on BAT factors. Regarding the age of the equipment, the fixed screen design has been used at TRT since the CWIS was constructed in 1904, and the current screen system and mechanical draft cooling tower are approximately 10 years old. The existing mechanical draft tower should continue to be operated at the facility, but the age of the current river intake system warrants an upgrade. In consideration of engineering feasibility, TRT would have to install a new system that is larger than the existing tower in order to supply sufficient cooling capacity with the towers as compared to what is achievable using the seawater system. Space for a new cooling tower system appears to be a limiting factor, as, according to the permittee, there is no adequate ground space for additional cooling towers, and Building 16, upon which the existing tower is located, is the only building on-site that is structurally capable for housing a cooling tower. Regarding process changes, additional mechanical draft cooling towers would require a complete retrofit of the cooling water connections. Expected non-water quality environmental impacts of a new cooling tower are the potential to create a salt drift, noise, and visual plumes. These non-water quality impacts associated with cooling towers, can likely be abated. Other non-water quality impacts include operational challenges and the loss of efficiency associated with the lower cooling capacity of cooling tower water as compared to once-through water, the energy penalty resulting from the additional energy use for operation of the towers, adverse aesthetic impacts, and consumptive freshwater use.

Although this technology would substantially reduce the volume of water withdrawn from the Weymouth Fore River, and thus the impingement and entrainment of aquatic species associated with the CWIS, EPA has concluded that additional closed-cycle cooling towers are not feasible at TRT at this time. This conclusion is based upon the insufficient cooling capacity of cooling towers as compared to the seawater system, the inadequate ground space at the TRT site, and the structural infeasibility of placing additional cooling towers on the roofs of existing buildings. As a result, EPA determines that additional closed-cycle towers are not available as BTA for TRT's NPDES Permit, at this time. EPA does, however, identify the operation of the existing mechanical draft closed-cycle cooling tower as a component of the BTA for TRT.

(2) – Alternate Sources of Cooling Water

The use of alternative sources of water, such as storm water, for cooling purposes could reduce the volume of seawater needed for cooling and subsequently would reduce impingement and entrainment. TRT currently collects rainwater from the northeast section of the facility for use as odor condenser feed water, which is then discharged to the pretreatment system and, ultimately, the local POTW. According to TRT, "the reused stormwater flow through the various processes amounts to approximately 9 gpm on average but tends to contribute to peak flows during rainfall events. While these volumes are relatively minor compared to the total annual use of once-through cooling water drawn from the Weymouth Fore River, it is a substantial proportion of water used in processes that would have otherwise required municipal supply for cooling tower makeup, washdown water and other uses." Based on the average flow, TRT's current stormwater collection system provides about 13,000 gallons per day, which equals 0.26% of the daily once-through cooling water flow. This flow, however, is not currently used for cooling.

The permittee did not evaluate the availability of re-using its wastewater, or "grey water" as cooling water. The facility's wastewater currently goes to Massachusetts Water Resources Authority's (MWRA) treatment plants. The permittee notes that the long-term upgrades to combined sewer overflows (CSOs) and the Deer Island and Nut Island treatment plants have eliminated the discharge of wastewater to Boston Harbor. Re-use of grey water at the facility would require TRT to design and implement a method to transport treated water from the MWRA treatment plant back to the facility for use as process water. According to the permittee, if the MWRA develops a water re-use program for tertiary treated water, the quantity and quality may only be sufficient to displace the use of municipal water at the plant, and is unlikely to reduce the need for once-through cooling water flow. In summary, methods to obtain treated wastewater from the MWRA do not currently exist, and furthermore the need for once-through cooling water flow is unlikely to be replaced by treated wastewater.

EPA evaluated the availability of alternate sources of cooling water at TRT based on BAT factors. Regarding the age of the equipment, TRT has been collecting storm water from the northeast portion of the facility to use as cooling water for over the past 10 years. In consideration of engineering feasibility, additional storm water would likely provide only the same or less volume of cooling water than the existing storm water collection system, which is less than 1% of total cooling water needs. Regarding process changes, in order to collect additional storm water TRT would have to install a new storm water collection system on the southwest portion of the facility. TRT would also have to redesign the cooling system such that it accepted sources other than seawater. Alternate sources of cooling water are expected to have no non-water quality environmental impacts.

Based on the minimal volume of stormwater currently collected from the northeast section of the facility for use in the odor stripping processes, EPA has concluded that expanding the existing stormwater collection system to supplement once-through cooling water needs would be unlikely to contribute a substantial percentage of cooling water flow and is not required at this time. In addition, according to the permittee, any additional stormwater or wastewater re-use would supplement the need for municipal water in the treatment and wash down systems. EPA has concluded that re-using alternative sources of water to supplement the once-through cooling water volume should be considered in the future if the opportunity arises, but alternative water sources are not available as the BTA at TRT at this time.

(3) – Scheduled Outages

In TRT's Response to EPA's Section 308 Request, the permittee stated that additional flow limitations could be implemented if the facility were to schedule its annual 5-day outage for maintenance with peak abundances of life stages/species that have the possibility of being entrained and/or impinged.

The main species of concern in the Weymouth Fore River are rainbow smelt and winter flounder. Rainbow smelt are currently being studied by the United States Fish and Wildlife Service (USFWS) for inclusion on its endangered species list and is also considered a species of concern for the National Marine Fisheries Service (NMFS) due to declining landings through the 1990's. Winter flounder is a commercially important species. The 2006 Mystic Station Study documented seasonal patters for entrained eggs and larvae and found that the vast majority of entrained eggs occurred between April and late July while entrained larvae occurred between February and early April (likely dominated by sand lance and grubby larvae), with a smaller peak from May to June. Winter flounder eggs and larvae are typically present during the spawning period from March through June. Additionally, the 1993 Ecology Study of the Weymouth Fore River indicated that the majority of rainbow smelt larvae occurred in May. Thus, scheduling outages to fall between March 1st and June 30th would include periods of peak ichthyoplankton density and would likely reduce entrainment of early life stages of winter flounder and rainbow smelt.

Scheduling maintenance outages to coincide with periods of high abundance of life stages/species would further reduce entrainment. In terms of the BAT factors, scheduled outages are not associated with any costs or engineering and non-water quality impacts. No process changes or implementation issues would result because the permittee is granted flexibility if, for operational reasons to be provided to EPA, they cannot comply within the specified time period. Thus, limiting the CWIS capacity to the maximum extent practicable by scheduling outages to coincide with periods of high abundance of life stages/species would constitute one component of BTA at TRT.

d. Summary

In summary, EPA evaluated several potential operational and technological improvements to minimize adverse environmental impacts resulting from impingement and entrainment at TRT. The resulting BTA determination was made on a case-by-case, BPJ basis in part informed by the six statutory factors used in setting BAT effluent limitations under 40 CFR §125.3(d)(3).

Regarding the location of the CWIS, although its situation in a productive estuary is not ideal, the mid-depth intake minimizes impingement of benthic adults and entrainment of buoyant and demersal eggs and is a component of the BTA for TRT.

Regarding the design and construction of the CWIS, EPA evaluated three exclusion technologies: Ristroph traveling screens, barrier nets/AFBs, and wedgewire screens. Fine mesh Ristroph traveling screens would reduce entrainment and impingement mortality, but require complete re-construction of the CWIS and a large space, and may not be biologically effective for the species of concern at TRT. Coarse mesh Ristroph traveling screens would minimize impingement mortality, but would require complete re-construction of the CWIS and technologies of comparable effectiveness are available at a lower cost. For these reasons, EPA concluded that Ristroph screens are not the BTA at TRT. Barrier nets and AFBs would minimize impingement with low TSVs, and AFBs are available, though not required, with openings small enough to minimize entrainment. Fouling of the nets could lead to maintenance and performance problems, and the existing boat dock could present installation challenges. Still, these technologies are available at TRT and can be a component of the BTA. Wedgewire screens could be customized to minimize both impingement and entrainment of some life stages/species. Cylindrical wedgewire screens may have space limitations and can be costly, but can be a component of the BTA at TRT. Vertical profile wedgewire screens could be installed and operated as a component of BTA because they are one of the most compatible technologies with the existing CWIS and would minimize impingement and entrainment at a cost less than that of other exclusion technologies.

Regarding the capacity of the CWIS, EPA evaluated several technological and operational options for TRT. Continued use of the existing VFDs is one component of the BTA for TRT because they reduce the overall capacity by 53% and reduce entrainment by a proportional amount. Because this technology is already in use at the facility, it has no impacts associated with the BAT factors. Similarly, continued use of the existing wet mechanical draft cooling tower is one component of BTA because it provides 5.5 MGD in process water flows that would otherwise be obtained from alternative sources, including the river. However, an additional cooling tower is not available due to limited space and operational limitations as a result of the reduced cooling capacity. Alternative cooling water sources, such as wastewater, are not available at this time because the facility exports its wastewater to off-site treatment and does not have the capacity to properly treat wastewater for discharge to Town River. Stormwater flows on-site are not sufficient to result in further substantial reductions in overall cooling water needs. Scheduling outages to coincide with peak ichthyoplankton densities does not have impacts associated with BAT factors and is a component of BTA.

4. BTA Determination

Based on current CWIS operations, information available at this time, and the location, design, capacity and construction of the CWIS, EPA has determined that TRT's CWIS has the potential to cause adverse environmental impacts due to impingement and entrainment. In order to minimize adverse environmental impacts, EPA has required the following components as BTA in Part I.D. of the draft permit: (i) the permittee must operate the existing VFDs to maintain a maximum daily withdrawal of 5 MGD or less, (ii) continue to operate the existing wet mechanical draft cooling tower, (iii) schedule plant outages between March 1st and June 30th, (iv) maintain the existing CWIS mid-depth location, and (v) install and operate an exclusion technology with an opening size no greater than 10 mm and a through-screen velocity of 0.5 fps or less. Any change in the location, design, or capacity of the intake structures must be reported to EPA, and may require a permit modification. EPA has determined that the anticipated environmental improvements to the Weymouth Fore and Town Rivers from these steps, as described in Section VII.B.2.c, warrant the expenditure discussed in Section VII.B.3.b(3) that would be required of the permittee. These BTA elements are described in more detail below.

Flow Reductions

In order to reduce the impacts of entrainment associated with this CWIS, EPA determined that continuing to achieve a minimum flow reduction of 50% from the design flow of 10 MGD by operating the existing variable frequency drive pumps and the existing mechanical wet draft cooling tower represents the BTA for TRT. This flow reduction saves as many as 7.4 million eggs and larvae annually. Reducing flows below 5 MGD by optimizing the use of VFDs to withdraw only the volume necessary to meet the facility's daily cooling water needs will further minimize entrainment and save more fish eggs and larvae. Similarly, continuing to operate the existing wet mechanical draft cooling tower provides a 5.5 MGD flow that the facility would otherwise likely obtain from the river. Thus, the operation of the existing cooling tower reduces the plant flow over 50% and saves fish eggs and larvae from being entrained.

Scheduled plant outages

Conducting routine maintenance shutdowns between March 1 and June 30 represents a component of the BTA at TRT. As discussed earlier, the highest concentration of fish eggs and larvae, including rainbow smelt larvae, occurs during this period. This measure would eliminate impingement, entrainment, and thermal impacts for approximately 5 days, since no water would be withdrawn or discharged to the Weymouth Fore or Town Rivers. The Draft Permit requires TRT to report the dates of the outages each year on the monthly DMR and, if the facility was unable to schedule the outages during the designated time, provide an explanation as to why this was not practicable.

Maintain existing CWIS location

Maintaining the existing location of the intake at mid-depth minimizes the impingement of benthic organisms, and minimizes the entrainment of both demersal eggs (such as winter flounder and grubby) as well as floating eggs (such as cunner and tautog). For these reasons, maintaining this intake location is the BTA at TRT.

Install and operate exclusion technology

TRT currently employs ½-inch mesh screens at the intake pipes with a through-screen velocity (TSV) of about 0.7 fps. Installing and operating a new exclusion technology with an opening no greater than 10 mm (0.4-inch), would prevent the entrainment of smaller organisms of concern. This opening size was chosen because it is considered protective of rainbow smelt young-of-year migrating from spawning areas upstream, but the Draft Permit allows the installation of an exclusion technology with an opening less than 10 mm. In addition, a TSV no greater than 0.5 fps is required for the new technology, which will minimize impingement consistent with levels considered protective by EPA. EPA has considered available exclusion technologies for TRT, including wedgewire screens, barrier nets, and aquatic filter barriers, and has concluded that, at a minimum, a profile wedgewire screen with a slot size less than 10 mm and maximum TSV of 0.5 fps is feasible at TRT and requires a minimal expenditure by the permittee. However, the Draft Permit does not specify the type of exclusion technology, but instead requires design specifications for opening size and TSV. In this way, the permittee is allowed the flexibility to design and install an available exclusion technology that best meets the parameters of their facility, provided they include the design specifications relevant to minimizing impingement and entrainment.

VIII. Essential Fish Habitat

Under the 1996 Amendments (PL 104-267) to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq. (1998)), EPA is required to consult with the National Marine Fisheries Services (NMFS) if EPA's action or proposed actions that it funds, permits, or undertakes, may adversely impact any essential fish habitat such as: waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. § 1802 (10)). Adversely impact means any impact which reduces the quality and/or quantity of EFH (50 C.F.R. § 600.910 (a)). Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Essential fish habitat is only designated for species for which federal fisheries management plans exist (16 U.S.C. § 1855(b) (1) (A)). EFH designations for New England were approved by the U.S. Department of Commerce on March 3, 1999. Table 2 includes a list of the EFH species and applicable life stage(s) for the Weymouth Fore River and Town River Bay:

Table 2: Essential Fish Habitat in the Vicinity of Twin Rivers Technologies

Species	Eggs	Larvae	Juveniles	Adults

Atlantic Cod (*Gadus morhua)*	X	X	X	X
Haddock (*Melanogrammus aeglefinus)*	X	X		
Pollock (*Pollachius virens)*	X	X	X	X
Whiting (*Merluccius bilinearis)*	X	X	X	X
Offshore hake (*Merluccius albidus)*				
Red hake (*Urophycis chuss*)	X	X	X	X
White hake (*Urophycis tenuis)*	X	X	X	X
Redfish (*Sebastes fasciatus)*	n/a			
Witch flounder (*Glyptocephalus cynoglossus)*				
Winter flounder (*Pleuronectes americanus)*	X	X	X	X
Yellowtail flounder (*Pleuronectes ferruginea)*	X	X	X	X
Windowpane flounder (*Scopthalmus aquosus)*	X	X	X	X
American Plaice (Hippoglossoides platessoides)	X	X	X	X
Ocean pout (*Macrozoarces americanus)*	X	X	X	X
Atlantic halibut (*Hippoglossus hippoglossus)*	X	X	X	X
Atlantic sea scallop (*Placopecten magellanicus)*	X	X	X	X
Atlantic sea herring (*Clupea harengus)*		X	X	X
Monkfish (*Lophius americanus)*				
Bluefish (*Pomatomus saltatrix)*			X	X
Long finned squid (*Loligo pealei)*	n/a	n/a	X	X
Short finned squid (*Illex illecebrosus)*	n/a	n/a	X	X
Atlantic butterfish (*Peprilus triacanthus)*	X	X	X	X
Atlantic mackerel (*Scomber scombus*)	X	X	X	X
Summer flounder (*Paralicthys denatatus)*				X
Scup (*Stenotomus chrysops)*	n/a	n/a	X	X
Black sea bass (*Centropistus striata)*	n/a		X	X
Surf clam (*Spisula solidissima)*	n/a	n/a	X	X
Ocean quahog (*Artica islandica)*	n/a	n/a		
Spiny dogfish (*Squalus acanthias)*	n/a	n/a		
Tilefish (*Lopholatilus chamaeleonticeps)*				
Bluefish tuna (*Thunnus thynnus)*			X	X

The once-through cooling system utilized by the facility has the potential to impact the EFH species and other aquatic resources in three major ways: (A) by entrainment of small organisms into and through the cooling water intake structure; (B) by impingement of juvenile and adult organisms on the intake screens; and (C) by discharging heated effluent to the receiving waters. A review of past studies indicates that several of the above species are present in the Weymouth Fore River and Town River Bay (refer to Part VII.B.2.). Additional species that are present in the vicinity of TRT, but not identified as EFH species, may be selected as prey by EFH species. If these prey species are affected by TRT's CWIS or thermal discharge, it may indirectly affect EFH species through loss of prey. Therefore, EPA recognizes that this facility's operation has the potential to cause adverse effects to EFH species.

A. Entrainment: The potential to impact aquatic organisms by entrainment largely depends on the presence and abundance of organisms that are vulnerable to entrainment, and the flow required for cooling. Other important considerations include the location and design of the intake structure. According to section 316(b) of the Clean Water Act, any point source that uses a cooling water intake structure must ensure that its location, design, construction and capacity reflect the Best Technology Available (BTA) for minimizing adverse environmental impact.

The EFH resources (including forage species) most vulnerable to entrainment in the vicinity of this facility are species that have positively buoyant eggs, and/or pelagic larvae. Of the EFH species previously listed, the following are potentially vulnerable to entrainment:

EFH Species	Egg	Larvae
1. Atlantic Cod	buoyant	pelagic
2. haddock	buoyant	pelagic
3. whiting	buoyant	pelagic
4. red hake	buoyant	pelagic
5. white hake	buoyant	pelagic
6. winter flounder	demersal, adhesive	pelagic
7. yellowtail flounder	buoyant	pelagic
8. windowpane flounder	buoyant	pelagic
9. American plaice	buoyant	pelagic
10. ocean pout	demersal	pelagic
11. Atlantic halibut	pelagic to sea floor	buoyant
12. Atlantic mackerel	buoyant	pelagic
13. Atlantic sea herring	demersal, adhesive	pelagic
14. Atlantic butterfish	buoyant	pelagic
15. Atlantic sea scallop	demersal, adhesive	pelagic

The most abundant species of eggs found during the 1993 study of the aquatic ecology of the Weymouth Fore River included tautog-cunner and windowpane flounder. The most abundant species of larvae found during this study included rock gunnel, sandlance, and rainbow smelt. These are species commonly entrained at other New England CWISs, and therefore they have the potential to be entrained in the CWIS at TRT.

B. Impingement: Organisms that are of a size too large to pass through the intake screens are still vulnerable to being impinged on the screens. Additionally, the intake location and design, and cooling water flow requirements are major factors in assessing impingement potential.

EFH species considered to be most vulnerable to harm from impingement have one or more of the following characteristics: (A) pass intake structures in large, dense schools as juveniles or adults; (B) are actively pursued as major forage species; (C) are attracted to the intake structure as a source of forage or refuge; (D) are slow moving or are otherwise unable to escape the intake current; and/or (E) are structurally delicate, and likely to die if impinged. Of the EFH species previously listed, the following species are potentially vulnerable to impingement based on their characteristics as outlined above:

EFH Species	Vulnerable Lifestage
1. Atlantic cod	juvenile, adult
2. pollock	juvenile, adult
3. whiting	juvenile, adult
4. red hake	juvenile, adult
5. white hake	juvenile, adult
6. winter flounder	juvenile, adult
7. yellowtail flounder	juvenile, adult
8. windowpane flounder	juvenile, adult
9. American plaice	juvenile, adult
10. ocean pout	juvenile, adult
11. Atlantic halibut	juvenile, adult
12. Atlantic sea scallop	juvenile, adult
13. Atlantic sea herring	juvenile, adult
14. bluefish	juvenile, adult
15. long finned squid	juvenile, adult
16. short finned squid	juvenile, adult
17. Atlantic butterfish	juvenile, adult
18. Atlantic mackerel	juvenile, adult
19. scup	juvenile, adult
20. summer flounder	adult
21. black sea bass	juvenile, adult
22. bluefish tuna	juvenile, adult

The finfish species most commonly collected during the 1993 aquatic ecology study of the Weymouth Fore River were winter flounder, rainbow smelt, Atlantic tomcod, windowpane flounder, little skate, grubby, Atlantic menhaden, alewife, and Atlantic silverside. These are species commonly impinged at other New England CWISs, and therefore have the potential to be impinged on the CWIS screen at TRT.

C. Discharge of Heated Effluent: The discharge of heated effluent may kill or impair organisms directly, elicit changes in normal behavior (alter normal migration patterns, cause avoidance of areas) or change normal trophic dynamics. The size and location of the thermal plume as well as the magnitude of the change over ambient temperatures (delta T) determine the level of thermal impact.

The Town River, to which TRT discharges the 5 MGD of heated effluent, is an intertidal estuary containing tidal mudflats. Table 3 includes information submitted by TRT regarding the thermal tolerances of several representative organisms:

Table 3: Thermal Tolerances of Representative Organisms for Town River Bay			
Species	**Primary Habitat Type**	**Upper Thermal Limit**	**Other Information**
Soft-shell clam	Intertidal estuaries with soft-bottom	34.4ºC (93.9ºF)	Clams occupying the high intertidal zone are more

		Based on LT50 for juvenile clams	tolerant of high temperatures than subtidal occupants
Atlantic silverside	Intertidal estuaries, salt marches, and tidal creeks	Tolerant of ranges between 3º-31ºC (37º-88ºF)	Often the most abundant fish in these habitats, within its geographical range
Mummichog	Intertidal estuaries, salt marches, and tidal creeks	Tolerant of regular exposure to 35ºC (95ºF). The upper lethal limit is 42ºC (107.6ºF)	Ubiquitous intertidal species known for high tolerance to water quality & physical parameters

D. EPA's Opinion of Potential Impacts to EFH Species: EPA does not believe that EFH species are significantly impacted by the thermal discharge; however, EPA is concerned about losses due to entrainment and impingement. Through a technological review of the facility, EPA determined that the steps outlined in Section VII.B.4. of this Fact Sheet should be taken to minimize entrainment and impingement mortality under CWA § 316(b). These steps have been incorporated into the Draft Permit at Section I.D. and include:

(i) Operating the existing VFDs to maintain a maximum daily withdrawal of 5 MGD or less;
(ii) Continuing to operate the existing wet mechanical draft cooling tower;
(iii) Scheduling maintenance outages between March 1st and June 30th, to coincide with periods of high abundance of life stages/ species;
(iv) Maintaining the existing CWIS mid-depth location; and,
(v) Installing and operating an exclusion technology with an opening size no greater than 10 mm and a through-screen velocity of 0.5 fps or less.

Additionally, the Draft Permit contains an Ambient Temperature and Mixing Zone Study to confirm the location of the mixing zone in the Town River Bay and that Massachusetts in-stream WQSs for temperature are met. Based on these requirements, EPA has determined that the Draft Permit ensures that the proposed discharge will not adversely impact EFH and that no consultation with NMFS is required. If adverse impacts to EFH do occur as a result of this permit action, or if new information becomes available that changes the basis for this determination, then NMFS will be notified and consultation will be promptly initiated. During the public comment period, EPA has provided a copy of the Draft Permit and Fact Sheet to NMFS.

IX. Endangered Species Act

Section 7(a) of the Endangered Species Act of 1973, as amended (ESA) grants authority to and imposes requirements upon Federal agencies regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitat of such species that has been designated as critical (a "critical habitat"). The ESA requires every Federal agency, in consultation with and with the assistance of the Secretary of Interior, to insure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The United States Fish and Wildlife Service (USFWS) administers Section 7 consultations for freshwater species. The National Marine Fisheries Service (NMFS) administers

Section 7 consultations for marine species and anadromous fish.

EPA has reviewed the federal endangered or threatened species of fish, wildlife, and plants to see if any such listed species might potentially be impacted by the re-issuance of this NPDES permit. Upon review of the current endangered and threatened species in the area, EPA has determined that there are no species of concern present in the vicinity of the outfalls from this facility. Furthermore, effluent limitations and other permit conditions which are in place in this Draft Permit should preclude any adverse effects should there be any incidental contact with listed species either in the Town River, Weymouth Fore River, or Hingham Bay.

EPA is coordinating a review of this finding with NMFS through the Draft Permit and Fact Sheet; however, further consultation under Section 7 of the ESA is not required. If adverse impacts to ESA do occur as a result of this permit action, or if new information becomes available that changes the basis for this determination, then NMFS will be notified and consultation will be promptly initiated. During the public comment period, EPA has provided a copy of the Draft Permit and Fact Sheet to both NMFS and USFWS.

X. Monitoring

The permittee is obligated to monitor and report sampling results to EPA and the MassDEP within the time specified within the permit. Timely reporting is essential for the regulatory agencies to expeditiously assess compliance with permit conditions.

XI. State Certification Requirements

EPA may not issue a permit unless the Commonwealth of Massachusetts Department of Environmental Protection with jurisdiction over the receiving waters certifies that the effluent limitations contained in the permit are stringent enough to assure that the discharge will not cause the receiving water to violate Sate WQSs. The staff of the Massachusetts Department of Environmental Protection has reviewed the draft permit, and advised EPA that the limitations are adequate to protect water quality. EPA has requested permit certification by the State pursuant to 40 CFR 124.53 and expects that the draft permit will be certified.

XII. Comment Period, Hearing Requests, and Procedures for Final Decisions

All persons, including applicants, who believe any condition of the Draft Permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to Sara Green, U.S. EPA, Office of Ecosystem Protection**,** Industrial Permits Branch, 1 Congress Street, Suite 1100, Boston, Massachusetts 02114-2023. Any person, prior to such date, may submit a request in writing for a public hearing to consider the Draft Permit to EPA and the State Agency. Such requests shall state the nature of the issues proposed to be raised in the hearing. A public meeting may be held if the criteria stated in 40 C.F.R. § 124.12 are satisfied. In reaching a final decision on the Draft Permit, the EPA will respond to all significant comments and make these responses available to the public at EPA's Boston office.

Following the close of the comment period, and after any public hearings, if such hearings are held, the EPA will issue a Final Permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments or requested notice. Within 30 days following the notice of the Final Permit decision, any interested person may submit a petition for review of the permit to EPA's Environmental Appeals Board consistent with 40 C.F.R. § 124.19.

XIII. EPA Contact

Additional information concerning the draft permit may be obtained between the hours of 9:00 a.m. and 5:00 p.m., Monday through Friday, excluding holidays from:

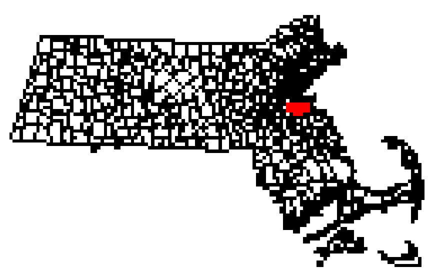
Sara Green, EPA New England – Region I
One Congress Street, Suite 1100 (CIP)
Boston, MA 02114-2023
Telephone: (617) 918-1574
FAX: (617) 918-0574
Email: green.sara@epa.gov

Paul Hogan, Massachusetts Department of Environmental Protection
Division of Watershed Management, Surface Water Permit Program
627 Main Street, Second Floor
Worcester, MA 01608
Telephone: (508) 767-2796
Email: paul.hogan@state.ma.us

Stephen S. Perkins, Director
Office of Ecosystem Protection
U.S. Environmental Protection Agency

7/10/2009

ATTACHMENT A
Twin Rivers Technologies Quincy, LLC (MA0004073)
Site Locus Map



Source: MassGIS USGS Topographic Maps
United States December 1995

ATTACHMENT B
Twin Rivers Technologies Quincy, LLC (MA0004073)
OUTFALL 001 – STORM WATER SAMPLING RESULTS
January 2003 THROUGH April 2009

MONITORING PERIOD END DATE	Flow (MGD)		pH (s.u.)		TSS (mg/l)		Oil and Grease (mg/l)
	Daily Maximum	Monthly Average	Daily Maximum	Daily Minimum	Daily Maximum	Monthly Average	Daily Maximum
30-Apr-09	0.0012	0.000024	6.57	6.57	7.6	7.6	-
31-Oct-08	0.0072	0.0072	7.05	6.96	ND	ND	ND
31-Jul-08	0.0028	0.0144	7.54	7.43	55	55	ND
30-Apr-08	0.0144	0.0144	6.9	6.9	ND	ND	ND
31-Jan-08	0.0072	0.0014	6.79	6.79	ND	ND	ND
31-Oct-07	0.00432	0.00432	7.95	7.95	ND	ND	ND
31-Jul-07	0.000008	0.000008	6.7	6.7	ND	ND	ND
30-Apr-07	0.01	0.01	8.05	8.05	1.6	1.6	ND
31-Jan-07	0.00005	0.00001	8.29	8.29	ND	ND	ND
31-Oct-06	0.000005	0.000005	8.29	8.29	ND	ND	ND
31-Jul-06	0.000008	0.000008	6.9	7.98	ND	ND	ND
30-Apr-06	0.03	0.002	8	8	12	12	6.3
31-Jan-06	0.0072	0.0072	7.91	7.91	20	20	ND
31-Oct-05	0.036	0.036	8.08	8.08	ND	ND	ND
31-Jul-05	0.0288	0.001	7.88	7.88	ND	ND	ND
30-Apr-05	0.00144	0.00144	8.5	8.5	9	8.2	ND
31-Jan-05	-	-	-	-	-	-	-
31-Oct-04	0.0028	0.0028	7.88	7.88	ND	ND	ND
31-Jul-04	NS	NS	NS	NS	NS	NS	NS
30-Apr-04	0.0072	0.00144	7.52	7.52	ND	ND	ND
31-Jan-04	0.000432	0.000432	7.53	7.53	ND	ND	ND
31-Oct-03	0.01008	0.01008	7.31	7.31	ND	ND	ND
31-Jul-03	0.0043	0.00432	6.77	6.77	ND	ND	ND
30-Apr-03	0.004	0.0014	6.7	6.7	ND	ND	ND
31-Jan-03	-	-	-	-	-	-	-

Permit Limit	**Report**	**Report**	**8.5**	**6.5**	**100**	**Report**	**15**
Minimum	0.000005	0.000005	6.57	6.57	1.6	1.6	6.3
Maximum	0.036	0.036	8.5	8.5	55	55	6.3
Average	0.01	0.01	7.51	7.55	17.53	17.40	6.30
Standard Deviation	0.01	0.01	0.61	0.61	19.32	19.39	-
# Measurements	22	22	22	22	22	22	21
# Exceed Limit	NA	NA	0	0	0	NA	0

‘ND’ denotes Non-detect ‘-’ denotes data unavailable ‘NS’ denotes no sample taken

ATTACHMENT B
Twin Rivers Technologies Quincy, LLC (MA0004073)
OUTFALL 003 – NON-CONTACT COOLING WATER SAMPLING RESULTS
June 2003 THROUGH March 2009

MONITORING PERIOD END DATE	Flow Rate (MGD)		Temperature (°F)		pH (s.u.)	
	Daily Maximum	Monthly Average	Daily Max Effluent Value	Daily Max Influent Value	Daily Maximum	Daily Minimum
31-Mar-09	5	5	48.7	40.9	8.22	7.81
28-Feb-09	5	5	38	47	6.8	6.6
31-Jan-09	5	5	42	40	7.05	6.96
31-Dec-08	-	-	-	-	-	-
30-Nov-08	5	5	54.9	52.1	7.54	7.43
31-Oct-08	5	5	67	66	7.56	7.54
30-Sep-08	5	5	37	-	7.56	7.54
31-Aug-08	3.5	3.5	71	68	7.68	7.62
31-Jul-08	5	5	70	66	7.82	7.4
30-Jun-08	3.5	3.5	74.12	57.02	6.9	6.81
31-May-08	-	-	-	-	-	-
30-Apr-08	3.5	3.5	53.6	51.4	8.02	7.89
31-Mar-08	3.5	3.5	50.9	44.6	7.03	6.59
29-Feb-08	3.5	3.5	66.6	42.8	8.02	7.9
31-Jan-08	-	-	41.4	37.4	8.02	7.93
31-Dec-07	3.5	3.5	38.1	42.1	7.98	8.07
30-Nov-07	3.5	3.5	49.1	46.4	7.92	8.01
31-Oct-07	3.5	3.5	59.2	55.2	8.08	7.96
30-Sep-07	3.5	3.5	67.6	64.9	7.97	8.16
31-Aug-07	3.5	3.5	73.8	68	8.06	8
31-Jul-07	3.5	3.5	75.6	71.8	7.96	8.09
30-Jun-07	3.5	3.5	73.4	67.5	7.96	8.01
31-May-07	3.5	3.5	68.4	61.2	8.02	8.11
30-Apr-07	3.5	3.5	50	51.8	7.86	8.08
31-Mar-07	3.5	3.5	50.4	44.8	6.8	7.1
28-Feb-07	3.5	3.5	41.2	34.9	7.96	8.01
31-Jan-07	3.5	3.5	48..6	42.3	7.86	8
31-Dec-06	3.5	3.5	48.56	44.06	7.99	8.02
30-Nov-06	3.5	3.5	53.96	50.54	7.93	8.05
31-Oct-06	3.5	3.5	53.96	47.84	7.93	8.13
30-Sep-06	3.5	3.5	68	64.4	7.91	7.97
31-Aug-06	3.5	3.5	74.84	71.06	7.87	7.96
31-Jul-06	3.5	3.5	75.2	70.34	7.89	7.95
30-Jun-06	3.5	3.5	74.48	66.74	8.07	8.17
31-May-06	3.5	3.5	57.37	54.14	8.09	8.21
30-Apr-06	3.5	3.5	52.52	59.36	7.91	8.08
31-Mar-06	3.5	3.5	50.18	42.44	8.03	7.76
28-Feb-06	5	3.5	41	37.58	8.09	7.98
31-Jan-06	3.5	3.5	41	32	8.07	7.98

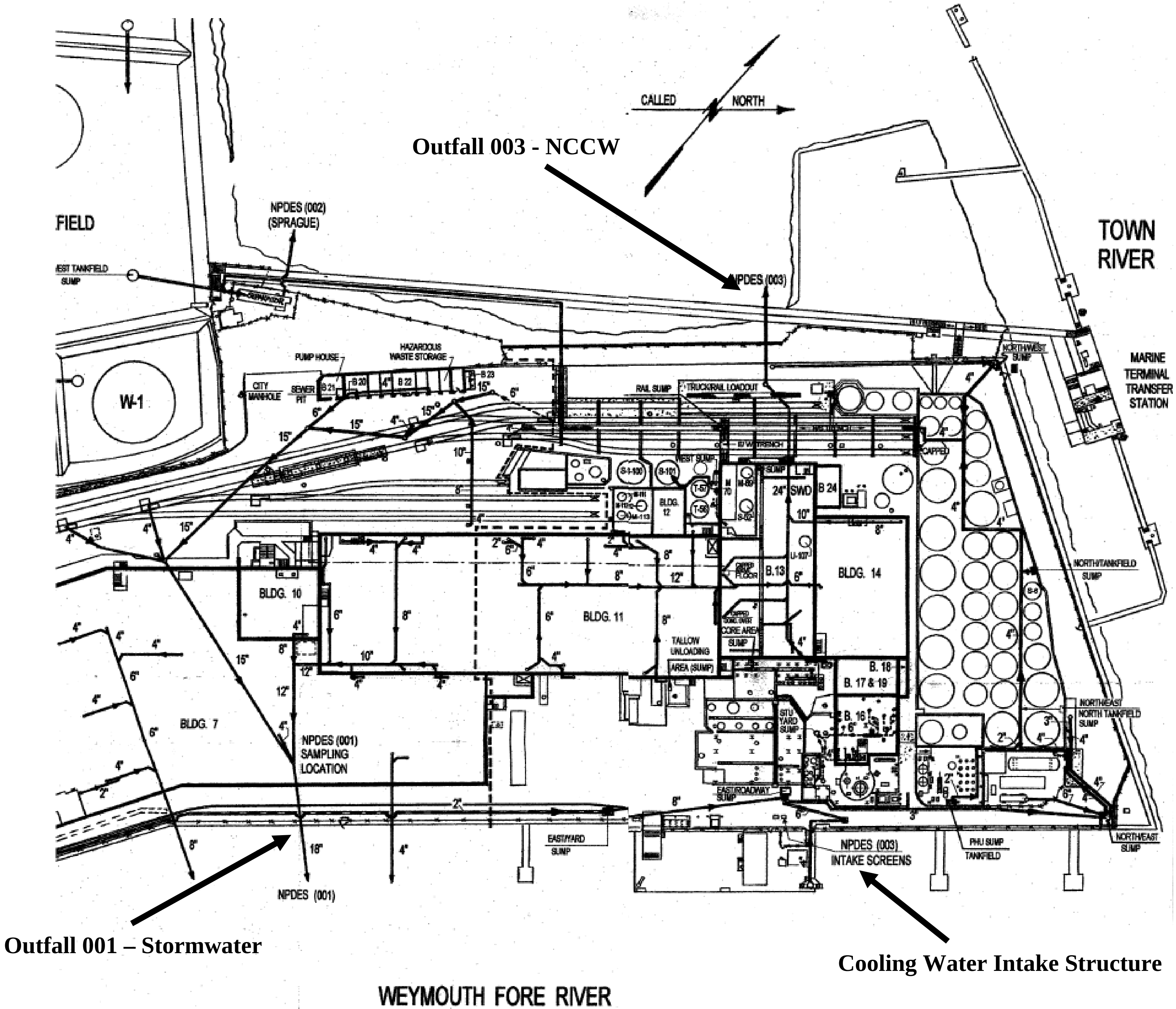
ATTACHMENT B
Twin Rivers Technologies Quincy, LLC (MA0004073)
OUTFALL 003 – NON-CONTACT COOLING WATER SAMPLING RESULTS
June 2003 THROUGH January 2009
(Continued)

MONITORING PERIOD END DATE	Flow Rate (MGD)		Temperature (°F)		pH (s.u.)	
	Daily Maximum	Monthly Average	Daily Max Effluent Value	Daily Max Influent Value	Daily Maximum	Daily Minimum
31-Dec-05	3.5	3.5	40.1	37.4	8.09	7.96
30-Nov-05	3.5	3.5	53.6	45.5	8.03	7.91
31-Oct-05	3.5	3.5	49.46	46.04	8.01	7.88
30-Sep-05	3.5	3.5	68.36	63.14	8.03	7.98
31-Aug-05	3.5	3.5	71.6	66.74	7.84	7.8
31-Jul-05	3.5	3.5	71.78	68.18	7.92	7.85
30-Jun-05	3.5	3.5	66.92	63.68	8.05	7.92
31-May-05	3.5	3.5	57.37	54.42	8.29	8.09
30-Apr-05	3.5	3.5	57.01	50.9	8.5	7.98
31-Mar-05	3.5	3.5	44.78	44.06	8.36	8.02
28-Feb-05	3.5	3.5	34.88	32	8.36	8.21
31-Jan-05	3.5	3.5	41	-	8.07	7.98
31-Dec-04	5	3.5	43.87	39.92	8.37	8.22
30-Nov-04	3.5	3.5	53.09	47.39	8.16	8.03
31-Oct-04	3.5	3.5	58.1	62.42	8.13	7.99
30-Sep-04	3.5	3.5	69.94	62.42	8.22	8.16
31-Aug-04	3.5	3.5	63.68	-	8.23	8.17
31-Jul-04	3.5	3.5	73.22	68.36	8.33	8.23
30-Jun-04	3.5	3.5	68.18	64.22	8.11	7.98
31-May-04	3.5	3.5	62.96	58.64	8.09	8.06
30-Apr-04	3.5	3.5	56.48	52.34	8.34	8.21
31-Mar-04	3.5	3.5	50.18	44.78	8.11	7.93
29-Feb-04	3.5	3.5	44.96	37.22	8.11	8.02
31-Jan-04	3.5	3.5	49.64	40.82	8.31	7.99
31-Dec-03	3.5	3.5	39.92	36.86	8.03	7.89
30-Nov-03	3.5	3.5	38.06	36.5	8.03	7.89
30-Sep-03	3.5	3.5	70.5	66.2	8.02	8
31-Aug-03	3.5	3.5	72.32	67.28	8.03	7.87
31-Jul-03	3.5	3.5	70.3	64	8.13	8.12
30-Jun-03	3.5	3.5	73.22	67.1	8.24	8.17

Permit Limits	**5**	**5**	**87**	**Report**	**8.5**	**6.5**
Minimum	3.5	3.5	34.88	32	6.8	6.59
Maximum	5	5	75.6	71.8	8.5	8.23
Average	3.70	3.66	57.10	53.02	7.95	7.89
Standard Deviation	0.52	0.47	12.61	11.88	0.35	0.36
# measurements	66	66	66	64	67	67
# exceed limits	0	0	0	NA	0	0

‘-’ denotes data unavailable

ATTACHMENT C
Twin Rivers Technologies Quincy, LLC
(MA0004073)
Outfall Locations



ATTACHMENT D
Twin Rivers Technologies Quincy, LLC (MA0004073)
Dilution Calculations

Month/ Year	Ambient Temp (F)[1]	Discharge Temp. (F)	Discharge Flow Rate		Volume Mixing Zone (Mgal/tide)[3]	Surface Area Mixing Zone (sq ft)[4]	Rise in Ambient Temp (F)[5]	Percentage of Available Dilution (%)[6]
			MGD	Mgal/ tide[2]				
Feb-04	33.31	44.96	3.5	0.875	1.67	47121.11	4	0.40
Mar-04	37.27	50.18	3.5	0.875	1.95	54886.29	4	0.47
Apr-04	40.06	56.48	3.5	0.875	2.72	76517.88	4	0.65
May-04	50.26	62.96	3.5	0.875	1.90	53610.59	4	0.46
Jun-04	58.51	68.18	3.5	0.875	1.24	34955.65	4	0.30
Jul-04	63.74	73.22	3.5	0.875	4.65	131096.03	1.5	1.12
Aug-04	62.80	63.68	3.5	0.875	0.00	0.00	0.88	0.00
Sep-04	63.55	69.94	3.5	0.875	2.86	80445.66	1.5	0.69
Oct-04	54.91	58.1	3.5	0.875	0.00	0.00	3.19	0.00
Nov-04	48.54	53.09	3.5	0.875	0.12	3377.24	4	0.03
Dec-04	34.85	43.87	5	1.25	1.57	44169.99	4	0.38
Jan-05	30.38	41	3.5	0.875	1.45	40798.03	4	0.35
Feb-05	33.44	34.88	3.5	0.875	0.00	0.00	1.44	0.00
Mar-05	36.48	44.78	3.5	0.875	0.94	26487.91	4	0.23
Apr-05	48.92	57.01	3.5	0.875	0.89	25206.03	4	0.22
May-05	53.63	57.37	3.5	0.875	0.00	0.00	3.74	0.00
Jun-05	61.20	66.92	3.5	0.875	0.38	10624.74	4	0.09
Jul-05	68.86	71.78	3.5	0.875	0.83	23270.90	1.5	0.20
Aug-05	63.80	71.6	3.5	0.875	3.68	103585.09	1.5	0.88
Sep-05	63.36	68.36	3.5	0.875	2.04	57585.62	1.5	0.49
Oct-05	51.98	49.46	3.5	0.875	0.00	0.00	-2.52	0.00
Nov-05	47.32	53.6	3.5	0.875	0.50	14063.61	4	0.12
Dec-05	34.40	40.1	3.5	0.875	0.37	10458.35	4	0.09
Jan-06	37.20	41	3.5	0.875	0.00	0.00	3.80	0.00
Feb-06	36.72	41	5	1.25	0.09	2500.35	4	0.02
Mar-06	37.64	50.18	3.5	0.875	1.87	52630.69	4	0.45
May-06	51.69	57.37	3.5	0.875	0.37	10341.25	4	0.09
Jul-06	64.60	75.2	3.5	0.875	5.31	149584.56	1.5	1.28
Sep-06	62.71	68	3.5	0.875	2.21	62318.68	1.5	0.53
Mar-07	36.63	50.4	3.5	0.875	2.14	60235.64	4	0.51
May-07	56.28	68.4	3.5	0.875	1.78	50029.97	4	0.43
Jul-07	64.47	75.6	3.5	0.875	5.62	158228.98	1.5	1.35
Sep-07	60.01	67.6	3.5	0.875	3.55	100117.46	1.5	0.86
Winter[6]	**33.28**	**87**	**5**	**1.25**	**15.54**	**437738.05**	**4**	**3.74**
Summer[7]	**65.25**	**87**	**5**	**1.25**	**16.88**	**475419.44**	**1.5**	**4.06**

Footnotes:

1. Data collected from MWRA buoy 124, located in Hingham Bay.

2. The volume discharged by TRT assuming the facility discharges 24 hours per day and that the average tide cycle occurs over 6 hours.

3. The volume of the mixing zone necessary for the discharge to meet Massachusetts Surface Water Quality Standards was calculated using the following relationship:

$$\text{Ambient Temperature after Mixing} = \frac{Q_D T_D + Q_A T_A}{Q_D + Q_A} = T_A + \Delta T$$

Where: Q_A = Ambient Flow Rate Q_D = Discharge Flow Rate
T_A = Ambient Temperature T_D = Discharge Temperature
ΔT = Change in temperature between the ambient temperature (MWRA Buoy 124) and the temperature after mixing with the heated discharge, to be measured at the edge of the mixing zone. A ΔT of 4 degrees was used for October – June while a ΔT of 1.5 degrees was used for July – September, according to Massachusetts Water Quality Standards

This equation, solved for Q_A, becomes:

$$Q_D T_A + Q_A T_A + Q_D \Delta T + Q_A \Delta T = Q_D T_D + Q_A T_A$$

$$Q_D T_A + Q_D \Delta T + Q_A \Delta T = Q_D T_D$$

$$Q_A \Delta T = Q_D T_D - Q_D T_A - Q_D \Delta T$$

$$Q_A = \frac{Q_D}{\Delta T}\left(T_D - T_A - \Delta T\right)$$

4. The surface area of the mixing zone was calculated by dividing the volume of the mixing zone by the depth of the tidal prism in the vicinity of the mud flats (4.745 feet).

5. Represents what percentage of the available volume and surface area of the tidal prism of the Town River Bay is required for the calculated mixing zone volume and surface area. The tidal prism was calculated as follows:

Tidal Height: The Town River Bay contains a large amount of tidal mud flats, which decrease the available dilution. The tidal height in the area is 9.49 feet; however, the tidal height in the region of the mud flats is estimated to be half this value, 4.745 feet.

Surface Area: The surface area of the Town River Bay at high tide was estimated using ARC-GIS. The total wetted space, starting at the channel entering into the Town River Bay, comprises 11,708,928 square feet. This area represents the surface area of the tidal prism.

Volume of Tidal Prism: The total volume of the tidal prism is calculated by adding the volume of water above the mud flats with the volume of water below the mud flats. However, based on the difficulty in calculating the surface area of the non-mud flat portion of the Town River Bay, the calculations in this attachment make the conservative assumption that all dilution comes from the volume of water above the mud flats. This volume is calculated by multiplying the total surface area (11,708,928 square feet) by the tidal height above the mudflats (4.745 feet), which yields a volume of 55,558,863 cubic feet, or 415.6 million gallons.

Volume of water above tidal mudflat (415.6 million gallons)

Volume of water below tidal mudflat

6. Average winter temperature of the surface of the Town River Bay, calculated using the five lowest values from 2004-2007.

7. Average summer temperature of the surface of the Town River Bay, calculated using the five highest values from 2004-2007.